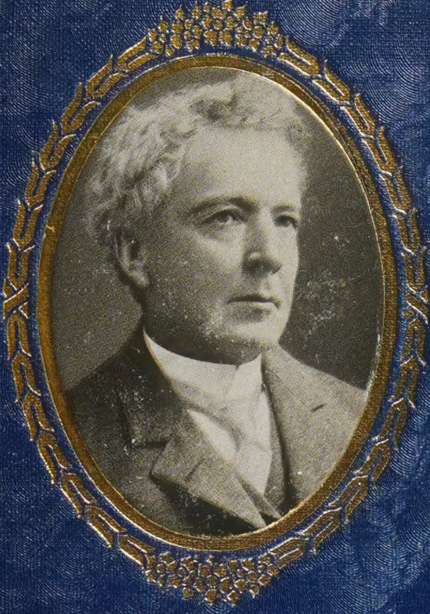

Luther Burbank

A Basket of Plums

These plums are typical of bushels that might be picked during the bearing season on Mr. Burbank's proving grounds at Sebastopol, consisting of specimens no two of which are precisely alike and no one of which is identical with any variety hitherto known. Mr. Burbank has introduced more than 60 new varieties of plums; but he has produced or developed thousands of varieties from which to select. The bulk of these are, of course, of use only for further breeding experiments; but there are many varieties still unnamed that merit introduction, and new varieties appear each year.

LUTHER BURBANK

HIS METHODS AND DISCOVERIES AND THEIR PRACTICAL APPLICATION

PREPARED FROM
HIS ORIGINAL FIELD NOTES
COVERING MORE THAN 100,000 EXPERIMENTS
MADE DURING FORTY YEARS DEVOTED
TO PLANT IMPROVEMENT

WITH THE ASSISTANCE OF

The Luther Burbank Society

AND ITS
ENTIRE MEMBERSHIP

UNDER THE EDITORIAL DIRECTION OF

John Whitson and Robert John

AND

Henry Smith Williams, M. D., LL. D.

VOLUME V

ILLUSTRATED WITH
105 DIRECT COLOR PHOTOGRAPH PRINTS PRODUCED BY A
NEW PROCESS DEVISED AND PERFECTED FOR
USE IN THESE VOLUMES

NEW YORK AND LONDON
LUTHER BURBANK PRESS
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Volume V—By Chapters

Foreword to Volume V

Unquestionably the greatest work which Mr. Burbank has done in the line of tree fruits has been with plums and that greatest plum of all, the prune. It has been his purpose in this volume, however, to limit in no wise its value to the plum and prune grower; but, because of the number and completeness of the experiments outlined, it is designed to have a broad, practical worth to the producer of other desirable new fruits, or in fact of any other plants.

The reader, by this time, must well realize that Mr. Burbank's methods, all of them, are *plant* methods rather than flower methods, tree methods or vegetable methods.

This book concludes with one of Mr. Burbank's most interesting achievements—the production of the plumcot, a combination between trees of different species, such as men of science had always thought to be impossible.

THE EDITORS.

The Blood Plum of Satsuma

This is the plum about which Mr. Burbank read in the Mercantile Library of San Francisco many years ago. His interest was aroused and he sent to Japan for the plant, along with others, and subsequently utilized it to very great advantage in his plant developing experiments. The original Satsuma imported by Mr. Burbank is the parent of all the red-fleshed plums now grown in America.

How the Plum Followed The Potato

Luther Burbank's First Work in California

WHAT you need is a complete rest and a change of climate. Go to California for the winter.

This, or something like this, I am told, is a very common prescription of the New York specialist, or for that matter, of physicians everywhere.

The value of rest is almost axiomatic, and the benefit to be derived from a change of climate is matter of familiar observation to layman and physician alike.

Now I have more than once called attention to the similarity between human beings and plants as to a good many of their hereditary propensities and environmental responses. And the present case furnishes another illustration in point.

Rest and change of climate are no less beneficial to the plant than to the human patient.

And as new surroundings arouse the mind and

give a fresh stimulus to the imagination, in the case of human beings both individually and collectively, so the transplantation of a plant to new soil sometimes brings out unsuspected racial tendencies and stimulates variation in such a way as greatly to improve individual specimens and quite to transform their progeny.

I had seen instances of this as applied to many different species of plants from the time of my first coming to California. I myself felt the mental uplift of new surroundings, and seemed to find evidence that plants that had come from the eastern United States, even as I had come, were not unmindful of a similar influence.

No species of plant or bird or animal is quite the same on the Atlantic and the Pacific seaboard. We have but to compare specimens of such familiar birds as the robin, quail, and meadow-lark, or of plants of any garden variety to note the evidence of beginning transformation.

My early letters from California told of my astonishment in seeing "great rose trees, thirty feet high; veronica *trees*, and geranium *trees*."

Of course in those cases where the species has been long resident in California the change has progressed so far that representatives of what were once members of the same clan no longer are to be classified as of the same species.

All of this, as I say, was observed from the outset when I came to California, just as many another man had observed it. Indeed these things are too patent to escape notice. But, unlike many others, I was impelled to inquire whether some useful application might not be made of the observed influence of the California climate on immigrant plants.

The Prescription Applied to Plants

In following up this idea I was led to apply to a vast coterie of plants the prescription which has become so popular with the present day physician in the treatment of his patients.

"Take a rest, and find a complete change of climate. Go to California—and stay there," was the modified form of the prescription as I gave it to the plants of the remotest regions of the globe to which I could send word.

And the result of the carrying out of this prescription will require some volumes in the telling. For the plants that came to me in response have furnished the chief material out of which a large proportion of my developments of new fruits, grains, grasses, vegetables and flowers have grown.

Perhaps foremost in the list of immigrant plants that have had a large share in my life work must be named a little company of plum seedlings that came to me at the very beginning of the period

when I was renouncing the calling of the regular nurseryman and determining to devote my entire attention to the development of new races of plants.

The capacity for development shown by this little company of seedlings was nothing less than phenomenal.

The change of climate from Japan to California was, seemingly, of all things precisely what they needed if they were to put forth their best endeavors to better themselves, and in bettering themselves to confer benefits upon humanity.

Perhaps it is not too much to say that the little company of twelve plum seedlings that came to me with my first successful shipment in 1885 constituted, from an economic standpoint, the most important importation of fruit-bearers ever made at a single time into America. For the immediate bud sisters of two of these seedlings constitute to-day varieties of plum that are recognized as standards everywhere; and from the progeny of these and the others were developed plums of such size and quality as not alone to give this fruit an altogether new standing in the markets of America, but fairly to revolutionize the plum industry in such far away regions as Africa, Australia, New Zealand, our own southern states, and the states of the Pacific Coast.

A Typical Chinese Plum

This is the plum technically known as the Prunus Simoni, its specific scientific name being given in honor of the man who introduced it into Europe. The Chinese plum was one of Mr. Burbank's earliest importations, and its hereditary strains have been blended with those of many other varieties in the gardens at Santa Rosa and Sebastopol.

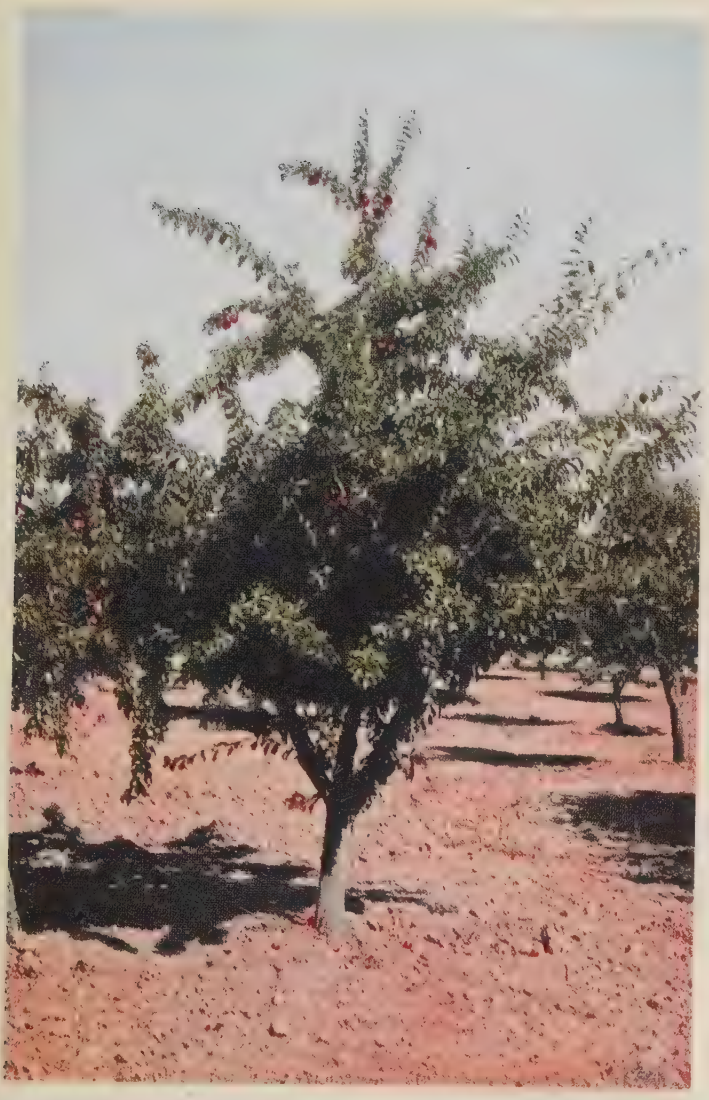
"Rest and a change of climate." It was a magical prescription as applied to the twelve plum seedlings from Japan.

And as to the plant physician who gave the prescription—for him personally the results were perhaps as notable as any other events in his life.

Already, when scarcely more than a boy in New England, he had had the good fortune to develop a new race of potatoes that had proved of vast economic importance, supplanting all other varieties of its tribe in widely extended regions, and making its way triumphantly round the entire world.

Now he was enabled, practically at the outset of his work as a professional plant developer, to introduce races of plums that followed and even out-distanced the potato, revolutionizing a great fruit industry in widely scattered regions of two hemispheres and preparing the way for other conquests in fruit development of which even now the limits are quite unpredictable.

Visionary indeed must have been the dreams of the would-be plant developer if his forecast of the possible result of his importation of the twelve little plum seedlings was more than a faint adumbration of the actual denouement. High hopes he had, yet doubtless in this case he builded better than he knew.



Typical Satsuma Plum Tree

This is an improved Burbank variety of the original Japanese Satsuma, produced by crossing with other species or varieties. It retains the red flesh of the Japanese variety.

I recall very vividly the precise stimulus that led me a number of years before the Japanese seedlings were actually imported to turn my eyes toward Japan as the probable source of a new race of plums.

A Sailor's Yarn and What Came of It

Browsing among the books of the Mercantile Library in San Francisco, I had chanced to come upon an account of the wanderings in Japan of an American sailor, and what particularly held my attention was his mention of a red-fleshed plum of exceptional quality that he had seen and eaten in the Province of Satsuma in southern Japan.

That red-fleshed plum appealed to me, and I determined to secure a specimen of it for my own orchards.

The sailor reported in his book that he had seen a single plum tree bearing this "blood-plum of Satsuma." But of course the rarity of the fruit made it the more alluring. So in due course when I came to make importations of native seeds, plants, and bulbs from Japan, I urged Mr. Isaac Bunting, an English bulb dealer in Yokohama who collected these for me, to visit the southern part of that country and make a particular effort to procure with others some of the red-fleshed plums.

Mr. Bunting complied with my request, but, vastly to my disappointment, the first lot of young trees he shipped to me arrived (Nov. 5, 1884) in such condition that I despaired of doing anything with them. I immediately sent a request for another shipment, and gave definite instructions as to packing.

A little over a year later, on Dec. 20, 1885, there arrived the twelve seedlings to which I have already referred. And this time, to my great satisfaction, the tiny trees were found in good condition.

A few days after these seedlings were received, I purchased the Gold Ridge Farm at Sebastopol, eight miles from my Santa Rosa place, and here as soon as they were large enough, cions from the twelve little strangers were grafted on to older trees and thus brought early to maturity.

One of them bore fruit the following summer and the others in the course of one or two succeeding seasons.

And so well had the little immigrants responded to the stimulus of new surroundings that each one of them revealed, I make no doubt, the very fullest possibilities of its heritage. More than that of course was impossible, but it may well be doubted whether any one of the company would have produced fruit quite of the same

order had it been nurtured in the climate and fed from the soil to which its ancestors had been habituated.

Rest and a change of climate could not give new hereditary possibilities, but they could be instrumental in bringing dormant possibilities to full realization.

How Rest Stimulates Growth

Possibly this statement requires a further word of explication, for I think we have not elsewhere emphasized—though the subject has been once or twice mentioned—the value of rest in enhancing the vitality of plants and in giving them new capacity for growth.

Of course nothing is more familiar—and therefore nothing seems more commonplace—than the annual dormancy of plant life in general throughout the winter season in temperate zones.

But until somewhat recently no one had particularly associated such dormancy with the vigorous growth of the reviving plants in the springtime.

It was familiarly known that tropical plants keep up their growth, even if somewhat intermittently, throughout the year; and it was assumed that the plants of temperate zones had taken on the habit of winter rest merely because this habit

The Fruit of the Burbank Plum

Mr. Burbank has produced thousands of plums, and has introduced three score varieties, but only one of these bears the name of "Burbank." This is the plum here shown which was grown by Mr. Burbank on a tree introduced from Japan. It is grown to-day in enormous quantities in the aggregate, under the most diversified conditions of soil and climate all over the world.

was forced upon them by the exigencies of climate. And indeed, there is no reason to doubt that such was really the origin of the habit of winter rest. We have had at least one illustration, in the case of the winter rhubarb, of the readiness with which a plant resumes the habit of perennial activity.

We suggested in that connection that perennial growth is the normal and primitive habit of the plant; and there is no occasion to modify that suggestion.

But even though the winter sleep of the plant was forced upon it, there is reason to believe that the habit thus inculcated is of great utility in conserving the energies of the plant and promoting its vital efficiency.

The experiments that justify this conclusion have been made in recent years by a number of different botanists, and they have conclusively demonstrated that it is quite the rule for a plant to develop exceptional powers of growth immediately after it comes out of a period of dormancy induced artificially.

Plants narcotized with the fumes of ether or chloroform, for example, are rendered quite incapable of growth while subjected to the fumes.

They are seemingly stupefied and their condition of dormancy or lack of vital activity is curi-

The Tree of the Burbank Plum

It will be seen that the Burbank plum has a sturdy, low tree, and that it is a very regular bearer. Fortunately the tree is very hardy as well. It is resistant to disease, and it will stand the rigors of the winter far to the north.

ously analogous to the unconsciousness of the narcotized human subject.

But so soon as the closed case in which plant and narcotizing fumes are confined is removed and the plants resume normal relations with soil and air, they take on at once a relatively prodigious and quite unprecedented capacity for growth, shooting upward at a rate that soon sends them far above their companion plants that have not been similarly put to sleep.

This obviously suggests that the rapid growth of the young shoots of herbs and trees in the springtime is probably enhanced greatly by the period of rest out of which the buds have just come. And the further corollary suggests itself that the period of rest forced upon a seedling that is, for example, dug up in Japan and shipped half round the world may ultimately prove of benefit to the seedling, stimulating it to such growth as it would not have found possible had not the period of dormancy been forced upon it.

Freezing "Rests" Animal Tissues

An analogy from the animal world which seems to have application is furnished by the recent experiments made at the Rockefeller Institute in New York by Doctors Montrose W. Burrows and Alexis Carrel.

In the course of their extraordinary tests in

the growing of animal tissues in an artificial medium, they discovered that such tissues might retain their vitality and capacity for growth not merely when cut from a living animal but when they were taken from the tissues of an animal recently killed.

And if the body of an animal was placed in cold storage from the moment of death, the tissues were found to retain their vitality and capacity for growth for many days, instead of for an hour or so only, as would have been the case had they not been placed in cold storage.

Moreover, the growing tissues themselves, which under proper conditions could be kept alive for weeks and even months, could be placed in cold storage at a freezing temperature and kept there for days without interfering with their subsequent capacity for growth. Yet, if the slides containing these same tissues were kept for half an hour outside the incubator in a room at ordinary temperature, they would inevitably die.

In Dr. Carrel's phrase freezing seemed to "rest" the tissues and give them new powers of growth.

When we recall that vegetable protoplasm and animal protoplasm are fundamentally of the same constitution, built of the same elements and subject in large part to the same rules of growth

and decay, the conclusion seems unavoidable that plant tissues also must benefit from "rest."

The application of these various experiments to the case of our seedling plums seems obvious and fairly convincing. The force of the analogy is emphasized by the reflection that the seeds of plums germinate far more rapidly after freezing. It may be recalled also that certain plants to be forced in the greenhouse in an off season will not respond well unless their roots are first frozen for a brief period. Such is the case, for example, with ordinary rhubarb.

Success at the Outset

But, of course, I would not be understood as implying that the rest gained by these little plum seedlings in the course of their long journey was the primary cause of the extraordinary vitality that they manifested.

For the full explanation of that, we must of course look to their ancestry, and we shall have occasion to make inquiry as to this in another connection.

Nor need we here raise the issue as to precisely what share the new conditions of climate and soil may have had in stimulating the strangers. Let what has already been said suffice for the moment as to this, and let us examine the notable members of the company more in detail

Crossed Plums

The picture shows some of the first crosses between the Burbank and the Satsuma. The various specimens here shown illustrate the variety of characteristics that come to the surface when different races are crossed. The bloom and crimson of the Satsuma and the orange of the Burbank are clearly in evidence. There is a wide enough range of variation as to size, flesh, stone, flavor, and sundry other characteristics to afford ample opportunity for selection.

as to the exceptional qualities that they presently manifested.

After all, it is more important to know just what the little seedlings achieved than to attempt to say just what share different causes had in the achievement.

In view of the very remarkable results, it should perhaps be explained that the Japanese plums are in general subject to great variation; the reason being that it has been the custom, which still prevails pretty largely, to raise the fruit from seed instead of propagating it by grafting, as is done in this country and in Europe.

So the little seedlings that came to me were doubtless of mixed heritage. In a word they had been produced by cross-fertilization between races not thoroughly fixed.

In dealing with them I profited by experiments that had been made, doubtless quite unwittingly, and with the aid only of insect pollenizers, in Japan in the preceding plant generation.

In any event, it was demonstrated in due course that the seedlings were a very remarkable lot. Each of the twelve produced fruit of interesting character, and two of them showed a product altogether out of the ordinary.

Both of these were introduced in 1889, and met with immediate and permanent success.

An Early Burbank-Satsuma Cross

The picture suggests a fruit worthy of introduction. This cross Burbank-Satsuma plum has size and beauty; nevertheless it was rejected. Probably its flavor did not seem satisfactory to Mr. Burbank, or there were other plums with the same combinations of qualities that were superior.

The one first offered to the public bore fruit in 1886, the summer after its importation. In my year book I described this fruit as "very large, conical, heart-shaped, red with white bloom; very good."

In point of fact the appearance of the plum, its size, and its delightful flavor and aroma at once proclaimed it as an exceedingly valuable acquisition.

Naturally I was pleased with it, and showed it to a number of prominent horticulturists who visited my experiment orchard during the next two or three years. Among these visitors was Professor H. E. Van Deman, Pomologist, U. S. Department of Agriculture. Professor Van Deman was much interested in this new fruit and suggested that it should be introduced immediately.

After talking over its qualities thoroughly, he requested that upon its introduction it be given the name of "Burbank."

Accordingly in 1889 this new fruit was offered to the public as the Burbank Plum.

The Career of an Immigrant

The story of the ultimate success of this fruit will be told statistically in another connection. Suffice it here that the Burbank plum presently outranked all others as a California shipping

The Prize Plum

This is a plum of the same parentage of the one shown in the preceding plate. That is to say, it is a cross between the Burbank and the Satsuma. The particular variety here shown proved of exceptional quality and was introduced under the name of the Prize.

plum, and at the present time in the east is the most popular and most generally offered for sale in the markets. Last year 125 carloads of this fruit were shipped to the eastern market from California.

Of course the career of this plum, like that of every other young fruit, has been subject to vicissitudes.

Some who have attempted to grow it in climates to which it is not adapted have considered it of small value. Yet there are few climates where it does not thrive; and for every orchardist who has tried it and found it wanting there are scores, throughout the world, who have been astonished and delighted at its value and have planted large portions of their orchard with this variety.

Although there are certain latitudes, certain conditions of humidity, and certain conditions of temperature under which it will not thrive, the Burbank has been able to adapt itself to more varied conditions than any other plum.

By way of illustration, I may cite a letter from an extensive grower at North East, Pa., who states that his orchard of Burbank trees survived the extreme cold of the winter of 1912-1913, during which the thermometer registered as low as thirty degrees below zero, and at the usual time in the

spring put forth blossoms abundantly that bore their habitual good crop of fruit.

Compare with this the opposite conditions of climate in some of our more southern states, and in some sections of Africa where the Burbank is extensively grown—and we have a story of remarkable adaptability on the part of this plum.

The Blood-Plum Satsuma

The other notable plant among the twelve seedlings was a representative of the race about which the sailor had written and about which I had read with such interest years before in the San Francisco Library.

This was, in short, a plum with red flesh, something hitherto unknown among the plums of Europe or America.

Red flesh in a plum is a character so conspicuous that it is not likely to escape attention even of the least observing. And my red plum had other qualities that made it well worthy of introduction. It first came into bearing in 1887, and two years later it was introduced under the name of Satsuma—the name being suggested, as was that of its companion the Burbank, by Professor H. E. Van Deman. The name seemed highly appropriate because it was the name of the province from which the plum had come.

Satsuma and its greatly improved hybrid de-

scendants have been most welcome additions to the fruits of America.

The original Satsuma is especially popular in Southern California and in the more eastern of the Gulf States as well as in the Southern hemisphere. It is a good healthy tree with rather narrow pointed leaves of medium size. It is not so adaptable to varying climates or conditions as the Burbank, being better suited to temperate and semi-tropical climates. Nevertheless it fruits well in some parts of New England. It is not large enough for general shipping, but is grown mostly for home use.

The fruit is globular and usually averages nearly two inches in diameter. The skin is red, covered with a thick pale blue bloom. The flesh is a dark purplish red, firm and of excellent quality when thoroughly ripe, though not to be compared with some of the hybrids which have been produced from it. It is esteemed for the table when fresh and for making jellies and jams.

Such peculiar interest attaches to this unique plum that I will quote an account of it given in "The Plums of New York," published in 1910:

"There is a group of several varieties of Triflora plums unique in having the flesh deep red in color and very firm and juicy. Of these red-fleshed plums, Satsuma was the first to be intro-

The Sultan Plum

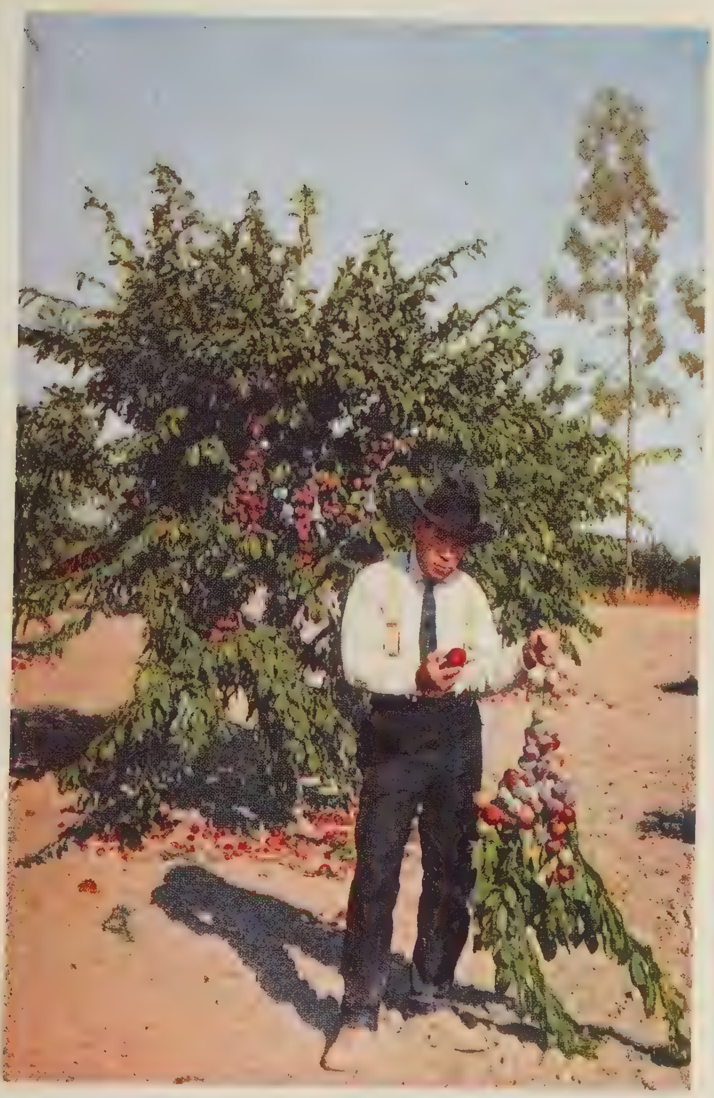
This is another variety produced by crossing the Burbank and the Satsuma. It is very different in appearance from the Prize plum shown on the preceding plate; but it has qualities of its own that highly commend it, and it was early introduced. It has maintained its popularity through the decades, and ***is now widely grown.***

duced into fruit-growing America and is one of the parents of most of the others. While the fruit is not as large nor as handsome in color as in some of its offspring, it is still one of the best varieties for quality of fruit and its trees are possibly as good as those of any of the other sorts of red-fleshed Trifloras.

"Satsuma, besides being one of the best of its class in quality for either dessert or culinary purposes, keeps and ships very well, and if the plums are of sufficient size and have been allowed to color properly, the variety makes a good showing on the markets. Too often, however, it is so unattractive as it reaches the market that it does not sell well. In the South the plums are said to be much attacked by brown-rot, but they are not more susceptible here than other plums. The trees are rather above the average for the species in size, habit, health, hardiness, and productiveness though they bear sparingly when young.

"They bloom early in the season and are distinguished from other Triflora sorts by having many spurs and short limbs along the main branches.

"In 1887 Burbank's tree was the only one bearing in America, but since then it has been tested in all of the large plum regions, having been introduced by Burbank in 1889. In 1897 it was



The Sultan Plum Tree

The tree in the background shows the typical conformation of the Sultan. The branch that Mr. Burbank's helper is holding suggests that among its other good qualities the Sultan is a prolific bearer. Mr. Burbank has produced a good many better plums in more recent years, but the Sultan must still be considered a very meritorious fruit.

added to the fruit catalog list of the American Pomological Society.

"Even though this plum is very distinct, with its solid red flesh, it is much confused with other sorts. A Japanese in a letter to J. P. Berckmans says 'Beni-smomo comprises a group of red-fleshed plums. In Satsuma, my native home, Hon-smomo and Yone-smomo are the most noted and familiar fruits of this group; the first is the smallest in size and deepest in color, while the second is the largest and most highly esteemed. In some districts, plums in this group are called Uchi-Beni, which means red inside.'

"Tree medium to large, vigorous, upright-spreading, usually quite hardy, moderately productive, bearing heavier crops as the trees become older.

"Fruit mid-season or later; one and seven-eighths inches by two inches in size, variable in shape, ranging from roundish-cordate to somewhat oblate, flattened at the base; color dark dull red, with thin bloom; dots numerous, of medium size, russet, somewhat conspicuous, clustered about the apex, stem slender, three-eighths inch long, glabrous; skin of medium thickness and toughness, semi-adherent; flesh dark purplish-red, juicy, tender at the skin, becoming tough at the center, sweet, with an almond-like flavor; of

A

Burbank-Satsuma Plum of 1913

Although Mr. Burbank made his first importations in the early eighties, and produced from them his first successful cross between the Burbank and the Satsuma in 1885, he has continued to experiment along these lines, and the color photograph shows a recent cross, still unnamed, between the original Burbank and the original Satsuma, which gives great promise.

good quality; stone semi-clinging or clinging, seven-eighths inch by five-eighths inch in size, oval, strongly pointed, rough, tinged red; ventral suture narrow, winged, dorsal suture grooved."

Descendants of the Satsuma

The red-fleshed plums because of their unique appearance have found a place especially in home orchards. On some markets, particularly in the northern part of the United States and Canada, there is a good demand for them as shippers. Eastern markets of the United States prefer plums of a lighter colored flesh.

So far as known, no one else has taken up the work of the production of red-fleshed plums. Nine others, however, in addition to Satsuma, have been introduced from my farms. These include Delaware, Santa Rosa, Beauty, Apple, Duarte, Hermosillo, Rubio, Prize, and Sultan.

The quality of some of the red plums is unexcelled by any others, and they are especially liked for making jellies, jams, etc. They add a richness of color which is not obtainable with any other tree fruit. Often the red-fleshed plums are added to other fruits for the purpose of producing an attractive color and desirable flavor. They also serve a useful purpose in furnishing a pleasing variety of fruits.

The Satsuma and Burbank were the only two

The Lieb Plum

This beautiful and delicious plum, named in honor of Judge Lieb, is of complex heritage. Among its ancestors are the Burbank and the Satsuma. But there are numerous other strains represented in its heredity. This plum has been successfully introduced and is widely grown.

among my twelve seedlings that were directly introduced, although sundry of the others subsequently had a share in the production of hybrid races. It should be recalled also that I had somewhat earlier introduced three plums of Oriental origin, namely, the Abundance, Chabot, and Berckmans, that were also the direct product of Oriental stock, grown and fruited by me from seedlings purchased from other importers.

I have not dwelt at length on them here because they seem of relatively less importance in retrospect than they appeared at the time when they were introduced.

Together with the Burbank and Satsuma they make up a group of five plums that were grown from imported seedlings, without hybridization, that ultimately came to be known wherever plums are grown.

But the Satsuma was the last plum introduced by me that was grown without hybridization from imported stock.

My next and all subsequent introductions were new races produced by crossing and hybridization, combining the heredities of widely varying species, and selecting the best from among thousands of seedlings. The story of the experiments through which these new races were developed belongs to the next chapter.

Four Burbank Plums, and How They Were Made

Methods Which Brought Unprecedented Success

"NATURE tells every secret once," says Emerson.

And this, after all, is only the poet's way of saying that there must always be someone who is first to *listen* to the secrets that Nature is *telling* every hour.

Once in my life, if I mistake not, I was privileged to listen to a secret that others had refused to hear or had heard but vaguely. Doubtless it had been whispered or half-whispered in many another ear. But in my ear Nature chanted this secret perpetually, insistently, and in compelling measure.

She told and re-told it to me until I had no choice but to listen.

The secret was this:

New species of animals and plants originate through the hybridization of old species.

[Volume V—Chapter II]

Stated otherwise, this means that so-called "spontaneous" variation, which Darwin found mysterious, is really due, or for the most part due, to the bringing together of diverse ancestral strains through cross-fertilization.

It is varieties thus developed that furnish material for the operation of Natural Selection, through which—as Darwin taught us—new species have been evolved in the past and are still being evolved.

I think I had more than half fathomed this mighty secret before I had made extensive experiments in plant hybridization. But in any event I had not gone far with my experiments in plant development before I found evidence piling up on every side to reassure me that what I had heard was no illusory voice but the voice of Nature herself.

Doubtless no single tribe of plants served me better in this connection, or were more obviously the medium through which Nature's great secret was revealed to me and corroborated, than the tribe of plums. And in the forefront of the company, in this connection, must be named the twelve little seedlings from Japan.

If I had entertained any doubt as to the correctness of my premonitions, the results achieved when these Japanese plums were allied with other

Plums of Chinese, Korean, and Siberian Types

Encouraged by his early success, Mr. Burbank kept on importing Asiatic plums. He found these for the most part inferior in size and in quality to the American wild plums, but they furnished the bases for further experiments. The plums at the bottom of the picture represent improved varieties of the original type; and the larger plums above are accidental hybrids produced from pollenization effected by the bees with neighboring species.

species from different parts of the globe would have settled the matter forever in my mind.

For when I mated these immigrants from the Orient with European stock, I saw produced "spontaneous" variations from the ancestral type of either parent in endless profusion—just such material as would be available in a wild stock for the operation of natural selection.

And ultimately, as will be told more at length in another connection, when I made still wider hybridizations, in which the apricot was one member of the alliance, there was produced in my orchard a new plant so widely divergent from either of its parent forms that few botanists if any would be disposed to deny it the rank and title of a new species.

I refer of course to the plumcot.

Having been, as it were, the agent of Nature in the development of this new species, I could never in future question the method through which species are commonly produced.

I applied the method in numerous other cases with corresponding results, as will appear in due course; but for the moment the plums have the platform and we are chiefly concerned with their share in the interesting and important revelation.

Why Individuals Vary

Doubtless I should never have been led to

Typical American Wild Plums

The American wild plum varies a good deal in different regions, out those here shown are typical—reddish in color, small in size, yellowish flesh, attractive though slight bloom, small stone clinging vigorously to the flesh. These plums possess a rich, characteristic flavor which has been introduced into many cross-bred new varieties by Mr. Burbank.

hearken to Nature's voice in regard to the development of species, notwithstanding its insistence, had it not been my good fortune to be passing through the most receptive period of adolescence just at the time when the new teaching of Darwin created a turmoil in every field of thought.

To me, from the outset, the teaching of the evolutionist carried absolute conviction.

Having no preconceptions to overcome, I was receptive to a point of view that to older men schooled in another line of thought seemed repellent or difficult. To me it seemed almost axiomatic that Darwin's teaching about the flexibility of species and the evolution of one form from another expressed the simple truth; for I had not been trained to observe Nature from the opposite point of view, as most of my elders had been trained.

So I cannot recall the time when the word "species," as applied to any animal or plant, was for me anything but a convenient symbol to designate a more or less transitory condition in which a particular family of organisms chanced at a particular time to find itself.

Following the teaching of Darwin, I could readily perceive that no two individuals of any species are alike; but that, on the contrary, variation is the universal rule in nature. And it was

in following up the clues thus suggested that I came to believe that the explanation of this variation must be sought in heredity.

I reflected that each normal organism has an ancestry that takes in vast numbers of individuals if we go back only a few generations—eight great-grandparents, thirty-two in the generation before, and more than a thousand within ten generations.

How then could the descendant of such a galaxy of ancestors, carrying the potentialities of all their traits, be otherwise than a complex organism not only different from either of its parents, but different also from any single member of its entire ancestral clan?

It seemed also a reasonable enough assumption that, where such a multitude of more or less divergent traits are brought together and put in conflict, the exact combinations of traits would be different in the case of each successive offspring of any given pair of parents; so that no two individuals of the same fraternity would be precisely alike, any more than any one of them would be precisely like any individual ancestor.

In a word, then, it seemed obvious to me that the individuals of a species constitute a variable and plastic race, in virtue of their diversified ancestral strains.

And if such variations are the natural result of the operation of the laws of heredity when closely similar individuals, ranked as of the same kind or species, are mated, it seemed reasonable to expect that still wider divergencies and diversities must be brought about in the offspring of a union between individuals so conspicuously dissimilar as to be ranked as members of different species.

Part of this, to be sure, was matter of common knowledge; for certain examples of the hybridizing of species in the animal world has long been familiar, the case of the mule being perhaps the most striking one under every-day observation. But this particular case illustrates the union of species that have become so widely divergent that nature appears to put a ban upon their union; permitting, indeed, the birth of offspring, but condemning the offspring to infertility. The inference that this case typifies the result of the interbreeding of species is utterly misleading.

To be sure, the tendency to erect barriers between species is obvious enough, for everyone knows that most of the others among our domestic animals cannot interbreed at all. But, on the other hand, if species are really only races diverged from a common origin, as Darwin thought, then there must have been a time when those

The Giant Maritima

The Maritima, colloquially known as the Beech Plum, is an American wild species, growing abundantly along many of the Eastern seaboards. The wild plum is very small and so acrid as to be almost inedible unless cooked. Mr. Burbank has greatly increased the size and quality of the fruit by selection, and he has also used it in highly interesting crossbreeding experiments.

that are now widely separated were nearer together and hence capable of interbreeding.

And as there are infinite gradations as to the amount of the divergence between the extant species of to-day, might we not reasonably suppose that there are many of these extant species that have not yet diverged beyond the point of hybridizing with the production of fertile offspring?

Testing the Theory

Just how far I had been carried along such lines of reasoning before I undertook to put the matter to a test, it would perhaps be difficult or quite impossible at this remote day to say with certainty.

But in any event my premonitions in the matter were sufficiently tangible to lead me, even when scarcely more than a youth in Massachusetts, to attempt hybridizing experiments. And the results of these experiments were sufficiently encouraging to give me early assurance that I was on the right track.

So it was with a very definite purpose in view that I began sending to the remotest regions for specimens of different species or varieties of garden or orchard plants, having full confidence that when I brought together these remote cousins I should find some at least that were still near enough to their common ancestral stem to be mu-

tually fertile; and being further assured that in such cases there would appear offspring in which the conflict of tendencies would produce wide variations, giving precisely the materials that were sought for such further selections and hybridizings as would result in the development of new and improved varieties.

At first the experiments were carried on in connection with the nursery business.

But about 1884 the work had developed to such an extent that I determined to devote the tract of eight acres purchased in Santa Rosa wholly to experimental work. Experiments had been conducted with garden vegetables, plums, apples, berries, nuts, and numberless flowers previous to this time, but generally on a small scale. Now, as I cast about for the most practical lines of procedure I was impressed with the demand all about me for better varieties of plums and prunes, especially for drying and shipping purposes.

My work as a nurseryman had taught me how urgent was this demand. I determined to undertake to meet it on a broad and comprehensive scale.

To lay the foundation for the real work in plums—to get the stock together, gain experience and knowledge as to the different species and va-

rieties, and test out their possibilities—was the work of twelve or thirteen years. Indeed, I may say that the work is still going on after the lapse of almost thirty years.

Yet I began to get conspicuous results almost at the outset, as will appear presently.

The Plum as Schoolmaster

In order that the work should be carried out as conceived, it was necessary that the various plums and prunes of the world should be brought together and, as it were, put into one melting-pot, in which a vast number of hereditary tendencies could be combined and re-combined. The right characters must be selected and wrong ones rejected. Out of the melange would arise new varieties better fitted to meet the old requirements, or adapted to meet altogether new requirements.

Here on my experiment farms the re-combination was to be effected, and the new products were to be sent forth to benefit not merely the home of their adoption but the world at large.

So well have we succeeded that to-day the sun never sets on these new productions. They are growing in every temperate zone of both hemispheres.

There is no country where the direct influence of these products is not felt in greater or less degree. But not alone as material products have

The Late Shipper

This is a Burbank cross between the Chinese and the Japanese plums. The Chinese parentage is shown in the short, thick, apple-like stem, clinging to the fruit, and the yellowish flesh. The influence of the Japanese parent is shown in the form of the fruit and in the stone, which inclines very strongly to the Japanese type.

they been important. An educational influence has radiated from these experiments, as performed here on my farms at Santa Rosa and Sebastopol. It is not too much to say that they have had a leading share in disseminating new views regarding plant evolution—and, reasoning from analogy, animal evolution as well.

The new varieties of plums have largely modified and expanded an extensive industry, making plums of the finest quality an every-day food for the masses instead of a luxury. The lessons inculcated by the experiments in hybridization through which these new races have been developed have served as a guide to countless other experiments in plant breeding, and have made views that seemed heretical thirty years ago seem commonplace matter of fact to-day.

They have almost revolutionized the work of plant improvement.

The materials through which this really significant modification both in the practice and the theory of plant development was brought about were drawn from five great divisions of the globe—five regions with different soils, climates, and natural conditions, and with a human population of correspondingly divergent habits and tastes.

And in return the new races of Burbank plums, prunes, and plumcots are being sent back

vastly modified and improved to the diverse regions from which their ancestors came, and in addition are making their way in some regions where no plum could be grown on a commercial scale before.

Material from the Orient

Clearly to apprehend the conditions of the problem that confronted me when I first undertook on a comprehensive scale to put my ideas as to plant development into execution, it is desirable to note very briefly the characteristics of the different races of plums that were brought to the Santa Rosa melting-pot. Let me outline them.

Reference has already been made more than once to the Japanese seedlings. The plums from this source, like those from every other, typify in many respects the people among whom they were developed. Modified to meet the needs of an island people occupying a relatively small territory which nevertheless compasses many degrees of latitude, the Japanese plums differ a good deal among themselves as to their hardiness. But in general they are rapid growers, with early and abundant bearing qualities, and unusual adaptability to wide ranges of climate. The fruit is unique in form. It averages large in size, with a high percentage of flesh to stone, and with both skin and flesh of high color.

The brilliant purple, crimson, and pink shades shown by some of the modern hybrids are a tribute to the Japanese members of their ancestral stock.

But while the Japanese plums have these signal merits they are not without their faults. Many of them are small and most of them lack flavor. Freestone qualities have not been developed in the slightest degree. Many of them lack timeliness of bearing; others bloom so early that the crop is often destroyed by late spring frosts or heavy rains.

Moreover the Japanese often eat plums that are hard and green, preserving them by pickling; therefore they sometimes neglect to appreciate the sweetness and flavor of the fruit.

These, obviously, are defects that the plant improver must bear constantly in mind when he sets out to separate and recombine the traits of his company of plums.

The Chinese, near neighbors of the Japanese, developed plums of a different type. The Japanese plum is known as *Prunus triflora;* it perhaps originated or was developed in Korea, Southern Siberia, and Northern China. But the Chinese apricot-plum, known to the botanist as *Prunus simonii,* must have originated in some semi-tropical climate. It has form and color sug-

A Kelsey-Satsuma Hybrid

The Kelsey is an Oriental plum, not imported by Mr. Burbank, but used by him in hybridizing experiments. The hybrid here shown resembles the Kelsey in form, but shows the influence of the other parent in the matter of color. It is an interesting product, but was not thought worthy of introduction.

gestive of a tomato. It perhaps originated near the native home of the apricot, to which fruit it appears to be somewhat more closely related than to other plums.

The fruits of China, apparently, have not been greatly modified for many centuries. They therefore tend to fixity. Indeed, they furnish a typical example of the way in which the conservatism of a race may be stamped upon its fruit. Or is it that people and plants alike are conservative because of the climatic conditions that environ them?

In any event, the Chinese plum, when hybridized with other species of plums, brings to the union characteristics that are highly important.

Thus the Chinese plum has a delightful aroma, it is of unique form and rich color, and the stone is very small in proportion to the flesh.

On the other hand this plum is chiefly adapted to arid, semi-tropical climates; the fruit is likely to remain bitter, and it may crack so badly as to be utterly worthless.

Fortunately the merits may be retained, and the faults eliminated, in the hybrid progeny.

Materials from Europe and America

The European plum manifests no less markedly than the oriental one the tastes of the people by whom it has been developed.

Jordan Plum
Fruits

This variety is remarkable because it is the only Japanese plum having snow white flesh, instead of the yellowish or reddish flesh that characterizes other varieties. It has been used in hybridizing experiments.

European fruit growers have had in mind many and diverse qualities of fruit, and they have developed diversified races of plums. The original species from which these have grown is known as *Prunus domestica.*

Doubtless at a time sufficiently remote this plum was of the same ancestral stock with the Japanese and Chinese species. But many centuries of modification to meet the tastes of the Caucasian races have so altered it that it would be difficult to say what were its original characteristics.

The Western races, carrying the plum with them to different regions, developed widely different tastes and inclinations, and the plums that were ultimately grown to meet the tastes are of course equally diversified in quality. Some are large and some small; some exquisitely sweet, others relatively sour. Some are adapted to eating while fresh; others are most useful for drying or for canning.

In a word, the races to which the western plum has catered are of complex lineage; they live in widely varying climates and under greatly diversified conditions.

The Caucasian lives everywhere and his fruits have adapted themselves to his condition.

Summarized in a few words, the advantages

Tri-Parental Seedlings

This crossbred plum has the color of the Satsuma, the general appearance of the Burbank, and the shape and form of the Kelsey; and these are the parental strains which are represented in its heritage.

of the European plums are: wide diversity as to colors, qualities, and flavors, and adaptability to a wide range of climate.

The faults of the European plums are these: the stone is quite generally too large for the size of the fruit; the fruit itself in most cases is too juicy—sometimes absolutely watery—and there is a wide range of textures to be avoided, including stringiness, brittleness, and sponginess. Moreover, large size and exquisite quality are seldom combined. The green gage, the standard of excellence among the hardier European plums, is quite small, and the tree is unproductive. And the large European plums are quite often lacking in texture and flavor.

Size and quality are not correlatives in the case of these plums.

It must be especially noted, however, that it is the European plum, in some of its varieties, that has the qualities of large sugar production that permits it to dry readily in the sun without fermentation. This variety of plum, known as the prune, has been the means of building up a great world industry. At the moment, however, we are chiefly concerned with the plums in general rather than with this particular race.

There remain the American plums—that is to say the plums that were found growing in Amer-

The Challenge Plum

This crossbred plum shows the influence of its Chinese parents in the remarkably short stems; in fact, as will be seen, it is almost stemless. This is a great merit, keeping the heavy fruit from swinging in the wind and perhaps breaking loose.

ica at the time of European discovery.

There are several quite distinct species of these indigenous plums. They grow far to the north, and perhaps their most important characteristic is their hardiness. Some of them resist the scorching heat of tropical America; others thrive and bear in the short seasons of the snowy north. With hardiness of tree has been developed a strain of productiveness. Various wild plums often cover the ground in the fall with layers of ripened fruit.

Notwithstanding this, however, the crop is uncertain, some of the thriftiest trees proving unproductive in certain seasons, and the fruit is always inferior in size.

Many of the American plums are of fine quality, even in the wild state. Yet their faults are almost as numerous as their virtues. The trees are generally small, not usually large enough to make good commercial orchard trees. In form, too, the trees are defective. And the fruit, notwithstanding its excellent flavor, is often soft and watery, quite lacking shipping quality.

In the Melting Pot

Obviously, then, the plums of each country offer certain good qualities and present certain defects.

To take the characteristics from the plums of

A Faulty Beauty

This fruit is a Blood Plumcot; the plumcot being, it will be recalled, a cross between the plum and the apricot. This particular variety shows its Chinese parentage in its faulty habit of cracking; which renders it utterly useless for marketing purposes, notwithstanding the lusciousness of its flesh.

each country and combine them in different varieties; to eliminate the faults as far as possible; to select and test the best among the millions of seedlings produced from the various combinations; to redistribute these fruits when produced and thoroughly tested, sending them back greatly improved, their good qualities retained and others added—this has been the work of the plant originator in the attempt to produce an ideal plum.

Having for working material plums in which different combinations of qualities have been developed for the most part unconsciously from different races, our task was a consciously scientific selection.

We must strive to produce, in a few decades, changes comparable to those that had been wrought in the course of centuries through unconscious selection by many peoples under widely diversified climates and conditions. Conscious systematic selection was to amalgamate all the best qualities of plums and plum-like fruits; those that bore the imprint of the conservatism of the Chinese race, the insularity of the Japanese, the diversity of the European, the nomadism of the Persians, the hardiness and variability of the American.

The best was to be taken from each, and the good qualities developed in five widely varying

Santa Rosa Plum

This remarkable fruit is considered by Mr. Burbank to be one of the four best plums that he has developed. It is an exceedingly intricate cross-bred plum, combining the traits of ancestors from three continents. It is of comparatively recent origin, and will play a much more important part in the future, after its merits have come to be generally appreciated.

geographical territories were to be assembled, combined, sifted, and selected to produce fruit having the stability, novelty, variety, piquancy, hardiness, beauty and shipping qualities, and adaptability to new conditions and uses of the races that had left their imprint in varying measure on the ancestral stocks.

Viewing the work in retrospect, I assuredly have no cause to regret that it was undertaken, yet it has been a most laborious task.

Doubtless the time expended on the plum has been at least as great as that devoted to any other single line of my investigations. The labor, especially in grafting, budding, testing, and selecting, has probably been greater than that devoted to any other plant origination, with the possible exception of the spineless cactus.

Roughly speaking, I might perhaps say that the plum experiments represent, first and last, something about one-tenth of the total expenditure for my experimental work.

In importance, up to the present time, judged by results, the work with the plum may represent perhaps one-sixth of all my work; in extent and variety, perhaps one-tenth of the total. In commercial value, up to the present, perhaps the plums may be credited with one-third; but they will rank by no means so high when the final

Formosa Plum Fruits

This is another of Mr. Burbank's quartet of best plums. Like the one shown on the preceding plate, it is of mixed heritage. Formosa plums are surprisingly uniform in size, averaging about six inches in circumference. They are exceedingly attractive in appearance, assuming a rich red color on ripening. The juicy yellow flesh is almost free from the stone.

ledger is balanced, for there are other productions, among them the cactus, that loom large in prospective value.

So in the end perhaps the economic rank of the plums, among the total of my plant productions, will not be more than one-twentieth.

Yet when I state that from among the almost countless new varieties that have developed in my plum orchard, sixty-two have been thought worthy of introduction, and that some thousands of races are still undergoing tests, an inkling of the work involved will be gained. And when I add that the Burbank plums make up about one-third of the total export of the plums from California year by year, and that my proteges are as popular in South Africa, in Australia, and in numerous other remote regions of the globe as they are in the state where they originated, something of the economic importance of the experiments in plum development will be revealed.

Specific Results

Some glimpses have been given in earlier chapters of the methods of experimentation through which particular races of new plums have been developed; and fuller details of the methods and results will be given in subsequent chapters of the present volume. Here let me briefly outline some of the earlier results of my

Formosa Plum Tree in Bloom

This plum shows the influence of its Japanese parents, among other ways, by the habit of bearing fruit on the new wood as well as on the old.

effort at hybridizing the diversified races that were brought together for the purpose of these comprehensive experiments.

I have said that some notable results were obtained almost from the outset.

As illustrating this, it may be recalled that, whereas the first hybridizations between the Japanese seedlings and plums of European and American stock were made in 1888, there were no fewer than six varieties of hybrids in my orchard in the season of 1893, only five years later, that were considered worthy of introduction and that were able to take rank at once as superior in some regards to any plums at that time known.

Two of these, named respectively the Delaware and the Hale, were hybrids of a double oriental stock, one parent being the Kelsey, a Japanese plum introduced by the orchardist whose name it bears, and the other my Japanese Satsuma.

A third was a hybrid between a Japanese plum named the Sweet Botan, or Golden, and the Robinson, an American plum of the Chickasaw race.

Two others were crosses of the Robinson and Abundance.

The sixth was a cross between the Kelsey and the Burbank, its ancestral strains being therefore Japanese. This plum was first named Perfection,

but it was afterward renamed the Wickson, in honor of Professor Edward J. Wickson of the University of California.

All these are exceptional plums, but the Wickson is pre-eminent in virtue of its combination of good qualities. The tree grows upright, largely in vase form. It branches gracefully, and it is productive almost to a fault. The fruit is large and handsome. From the time when it is half grown to a few days before ripening it is pearly white in color, but all at once numerous pink dots appear, and in a few days it has turned to green flushed with crimson with a heavy white bloom. The stone is small and the flesh of fine texture, firm and sugary and delicious. It will keep two weeks or more after ripening; or it can be picked when hard and white, and will color and ripen almost as well as if left on the tree.

The general excellence of this fruit may perhaps best be gauged by the statement that last year more than one hundred carloads of this variety alone were shipped from California to the eastern markets.

Difficulties Overcome

But while these notable successes attended the earliest hybridizing efforts, it must not be supposed that the experiment was carried out without difficulty.

In point of fact it was not easy to effect the cross between the Japanese plums and the European varieties. Some varieties refused to combine; and probably not more than one in a hundred of these crosses proved in any way satisfactory.

When a hybrid is produced, the traits of the Japanese plum usually seem prepotent, though in some cases the balance between the two is fairly good.

Whereas the hybrids of the first generation sometimes produce fairly good fruits, as a rule their fruit is rather soft and acid. The full possibilities are revealed only in later generations, and in particular after other species and varieties of plums have been brought into the combination.

As rapidly as possible the hybridizations were extended, until forty-three races of plums had been used. In successive generations the various strains were intermingled until they were complex beyond computation or accurate recording.

The original seedlings were used as stocks for grafting the cions of new seedlings year by year. To this day they stand in the original rows, although little is left of the original trees except the trunk and the bases of the branches. Each season, the grafts that have been proved to be of

Beauty Plum Fruits

This is still another of Mr. Burbank's four best plums, and like the ones previously shown it is of comparatively recent origin and of very complex heredity. The Beauty is noted for the even ripening of the individual fruit; this insures good keeping quality, for a fruit that ripens unevenly starts to decay first at the point of ripening. The Beauty is also admirable in flavor.

no value are removed and cions from new seedlings are put in their place.

Most of the trees have borne from ten to twenty sets of grafts.

Details given in other chapters will enable the reader to follow in imagination the process of blending and selection through which, on the average, year by year a better and better combination of qualities was effected among my plum proteges.

Almost as a matter of course, there ultimately appeared individuals that far surpassed most of the earlier hybrids in one or many desired qualities.

The Quartette of "Best" Plums

And in the course of years there were found at least three new varieties, all of the most complex ancestry, that excelled any of their forerunners with the single exception of the Wickson.

The three new claimants, which stand as the finest products of plum development up to date, have been named the Santa Rosa, the Formosa, and Beauty.

These with the Wickson may be listed as unqualifiedly the best products of the experiments in plum hybridization up to date—a quartette of plums of matchless quality.

It must be understood, however, that there are

The Wickson Plum

This is the fourth member of Mr. Burbank's famous quartet of plums. Unlike the others, it was developed many years ago. Its ancestors were the Kelsey and the Burbank. The plum was first named the Perfection, but was subsequently re-christened the Wickson, in honor of Professor Edward J. Wickson, of the University of California. This plum has extraordinary shipping qualities, and has attained great popularity.

unfulfilled possibilities of future development among the hybrids of my plum orchard. Selection has gone on year after year until the plums that remain are all of complex ancestry and of fine individual quality. New crossings between the almost numberless varieties, or even new seedlings without further crossing, may result any year in producing a better plum than any hitherto produced. Indeed, this is to be expected, for in a sense the work is only begun.

Even by hastening the time of fruiting through grafting seedlings on small limbs in the way already detailed, it is impossible to test any given seedling as to its fruit possibilities in less than two or three years. So there are only twelve to fifteen generations at most between my first hybrids and the seedlings of the present year.

It is not to be supposed that all the possibilities of the multiple ancestry will be realized in any given individual within that comparatively short number of generations.

So, notwithstanding the notable results of the experiments up to the present, I have every expectation that the real greatness of my plum colony is yet to be revealed.

Meantime it is gratifying to record that unprejudiced witnesses in many parts of the world have declared the members of the quartette just

A Wickson Hybrid

The plum here shown duplicates in many ways the appearance of the Wickson parent, although it shows perhaps a greater tendency to assume the form of the Kelsey. It is not as palatable as it looks; it is shown as illustrating how a crossbred fruit may simulate the appearance of its most valuable parent, and yet have no commercial value.

named to be each in its way without a rival. Each of the four has certain points of excellence, to meet the requirements of a different market. But, as a group, the four stand in a class by themselves.

And in token that this is not a matter of accident, let me recall that in the production of these four plums selection has been made, in the course of successive generations, from not fewer than a million seedlings. Perhaps this bald statement will serve, in connection with what is elsewhere told of methods, to give a fairly vivid impression of the work involved in the attempt to develop a perfect plum.

—We must strive to produce in a few decades, changes comparable to those that had been wrought in the course of centuries through unconscious selection by many peoples under widely diversified climates and conditions.

The Greatest Plum of All—The Prune

Forty Years in Search of a Perfect Prune

IT not unfrequently happens that a visitor from the east expresses a particular desire to see a fresh prune. And when the fruit is shown the visitor usually expresses surprise at its appearance.

"Why, that looks just like a big plum," said a young woman who was shown a specimen of my finest variety.

"Taste it," I said.

"It tastes exactly like a plum, too," she declared.

"There is every reason why it should," I assured her; "for it is a plum. Not only so, but you have probably eaten any number of prunes in New York, even though you supposed that you had never seen a fresh one. The prune is an excellent table fruit and my best varieties are very good shippers.

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"So a fair proportion of the best plums that are sold in the eastern market are really prunes. Yet, of course, they are called plums when sold to be eaten fresh.

"And this is proper enough, for every prune is a plum, even though every plum is not a prune by any manner of means."

It is rather curious that this elementary bit of botanical information should not be more widely known. But my experience tells me that comparatively few persons living away from a prune growing district realize that the fruit with which they are so familiar in the dry state was neither more nor less than a plum before it was dried.

In point of fact a prune might be spoken of as a plum educated—and educated in a particular way.

In a sense all plums of the present day are educated. Each one has been brought, by selection, in the course of centuries to a point where it is a highly edible fruit. My famous quartet of developed plums, named in the preceding chapter, are assuredly educated in a high degree. Each of them is large in size, attractive in color, delicious in flavor, and of such firm quality of flesh as to bear shipping to distant markets.

Yet no one of them has the particular kind of education that is absolutely essential for a prune.

Prune D'Agen Fruit

This is the French prune originally brought to California more than 50 years ago, and grown almost exclusively until the appearance of the new Burbank prunes. It is a small, sweet fruit with a tough skin, growing on a weak tree of comparatively poor bearing qualities. This prune has been used extensively by Mr. Burbank in his hybridizing experiments.

Neither Wickson nor Santa Rosa nor Formosa nor Beauty plums would have the slightest value as additions to the orchard of the prune grower. The smallest and the poorest prune in the orchard would be preferred.

Yet the qualities that these educated plums lack are very few. Or, stated otherwise, the points of education that the prune has acquired, over and above other plums, are few. But they are absolutely essential.

The qualities in question are simply these: A capacity to produce a large percentage of sugar and store it in the juices of the fruit; and, secondly, a capacity to produce a skin-covering having a peculiar quality of cracking in just the right way when the fruit is plunged into an alkali bath. Granted these qualities, any plum is a prune; lacking them, no plum is a prune of value.

As to the varying degrees in which the qualities may be attained by different races of prunes, we shall have more to say in a moment.

Going Back to the Blanket

In order to get a clear view of the matter, it will be well for us to make inquiry as to just how the prune came to take on the particular kind of education that now gives it distinction. By so doing we shall perhaps be enabled to understand better why it is that the prune finds it so easy to

lapse back from the standards its forebears have established.

If I have been engaged in a forty year long quest of a perfect prune, without quite attaining the ideal, it is chiefly because this fruit shows such a propensity to forget what it has learned and to revert to the standards of the ordinary plum.

And the reason, stated in a word, is that the traits that now specifically characterize the prune have been acquired in comparatively recent generations; whereas the main characteristics that make the ordinary plum an edible fruit have been traditional in the family for untold centuries.

When I find our almost perfect prune lapsing back in the next generation to a condition that robs it of all value as a prune, I am reminded of the story of a young Indian who was taken from his tribe and given every advantage that the Government could furnish him.

Years were spent in teaching him the studies of the modern curriculum, mathematics, history, literature, language, and even a smattering of art.

At twenty-one he had a better education than many of our presidents, and his future was considered very promising by those who had to do with his training.

Ten years later this educated Indian was one of the most worthless of his tribe.

He had simply "gone back to the blanket stage of existence." The pull of past heredities was too strong upon him. The transitory influence of a few years of education could not efface the racial instincts that had been implanted through thousands of generations of breeding of a more primitive sort.

And so it is with the prunes. Through extreme specialization in recent times they have developed certain properties that were not of value to their ancestors, and, like the Indian, they are very ready to throw these off and revert to their blanket stage of existence.

So when we hybridize a prune with some fine variety of plum, or even cross two varieties of prunes, in the hope of getting a larger and more productive prune, we very commonly secure a fine fruit—a fruit sometimes that is in many ways superior to either parent—but a fruit that is not a prune at all in the technical sense; a fruit, in short, lacking the refinements of large sugar content and peculiar quality of covering; being, therefore, a mere plum—in a word, a blanket Indian.

And all this tends to show that we are right in assuming that the peculiar property of depositing a large quantity of sugar in the fruit is one that was not inherent with the ancestors of the prune

The Giant Prune and Its Parents

The Giant Prune was produced by Mr. Burbank by crossing the Hungarian and the French Prunes. It has many valuable properties in addition to its size, but it is sold as a plum and not as a prune. Its sugar content is not high enough to make it dry well.

until man undertook the education of the fruit and trained it for that particular purpose.

Remote Sugar-Producing Ancestors

Nevertheless all that we know of heredity suggests that the effort on the part of man to develop such a trait as this would not have been successful had it not chanced that there were among the ancestors of the prune some races that possessed a tendency toward the peculiar property of producing very sweet fruit. There is nothing anomalous in that supposition, however, for it is well known that many tropical fruits tend to have a high sugar content.

Such is the case, for example, with the date, the fig, and the pineapple.

The orange, also, in some of its varieties, is a very sweet fruit, and there are numerous others among the fruits still confined to the tropics that show the same quality.

Indeed, in general it may be said that fruits growing in the tropics tend to have a high sugar content, the reason being, perhaps, that in hot climates this is necessary to insure preservation of the fruit long enough to permit it to serve its purpose in protecting the seed during its growth and preparation for germination.

But as fruits migrate to temperate zones, they tend to give up this habit of sugar production. All

A Veritable Giant

The giant prune is here shown three-quarters its natural size. A glance shows why it is regarded as a valuable fruit by plum growers in many regions. This plum has proved especially valuable for shipping and for canning. When placed in boiling water the skin immediately rolls away from the fruit, leaving the rich, honey-colored flesh ready for the can.

pulpy fruits, to be sure, develop a certain amount of sugar, but the percentage is relatively small with most fruits of temperate climates. The contrast in this regard between the average wild plum and such a fruit as the fig or the date is very striking.

But we have seen illustrated over and over that a habit once ingrained in a race is with very great difficulty shaken off altogether, so it is not strange that, under exceptional circumstances or conditions of soil and climate, an individual plum tree might show reversion to the state of its tropical ancestor and produce a fruit much sweeter than other plums.

Such an individual, if its fruit came to the attention of the orchardist, would be likely to be preserved and propagated; and in the course of time, through selection among the seedlings of this tree, a race of sweet plums would be developed.

But it is only under conditions of artificial cultivation, in all probability, that such a race could be preserved.

For, of course, the production of a large amount of sugar must draw on the energies of the tree, and if this increased sweetness of fruit did not prove beneficial to the tree itself, natural selection would presently weed it out.

So, as I said, we may fairly assume that it is

The Giant Prune on the Branch

The fruits of the Giant are so placed on the tree that it will bear an immense load without breaking. The heavy fruits are borne on the strong wood near together, but far enough apart to obtain a good distribution of weight. This plum is now grown extensively in Australia and New Zealand, as well as in many other countries.

only within the comparatively recent period since the plum was under cultivation that the development of a race of sweet plums, which we now term prunes, has taken place.

Just the Right Skin-Texture

As to the other characteristic prune trait, that of developing a skin of such texture that it will crack in precisely the right way when put into the alkali bath, this may fairly be assumed to be an even more recent acquisition.

Yet here, again, we may assume that there were ancestors of the plum that developed characteristics of skin of which this is a reminiscence. And it is not very difficult to conceive how this may have come about.

The wild plum quite commonly grows along the water courses and by lakesides. It may chance that plums growing along the shores of the Mediterranean, or perhaps by some inland body of salt water like the Dead Sea, were covered on occasion with salt spray from dashing waves or saturated with the brine when they fell to the earth.

In such case, varieties that chanced to endure this treatment best would be the ones preserved, and in due course a race of plums having the right texture of skin to stand this treatment would be developed.

This particular quality of skin would doubtless

be subordinated when the plant migrated to regions away from the salt water and hybridized with other races. But here as before the latent trait would be preserved as a submersed factor in the germ plasm, ready when the occasion arose to make itself again manifest.

But how, it may not unnaturally be inquired, would man himself discover the value of the alkali bath in preserving the prune?

Granted that a prune had been evolved through artificial selection that had a sufficiently high sugar content to make it a drying prune, how chanced anyone to hit upon the particular method of drying that is now employed, an essential preliminary of which is the submersion of the fruit in the alkali bath?

The question is doubly pertinent because even to this day in France the use of this method is by no means universal. In many cases the prune is still dried with the aid of artificial heat, the fumes and smoke of wood or charcoal taking the place of the alkali bath in giving the right quality to the skin and aiding in preservation. So we may assume that the simpler method of using an alkali bath is of very recent origin.

Not unlikely the discovery was made altogether by accident.

Many of us can recall that in our boyhood days

it was customary in New England to make lye for use in the manufacture of soft soap by percolating water through barrels filled with wood ashes. The lye thus made is closely similar in composition to the fluid that is now used in preparing the prune. It seems a reasonable conjecture that the discovery of its value in this connection may have resulted from observation that plums which chanced to drop into a bucket of lye, when removed and thrown aside were more resistant to decay than other plums.

Such a chance observation would have sufficed to give the clue to some ingenious person, and the value of lye as an aid in making the plum into a dried fruit would thus come to be understood.

But whether or not this was the manner of discovery, the fact remains that the lye bath is an essential part of the process of curing the prune. Therefore the quality of skin that adapts the fruit to respond properly to this treatment is one of the absolute essentials that the fruit developer must have constantly in mind.

How Sugar and Lye Co-operate

It may seem rather curious at first glance that a high sugar content should be essential to the preservation of the prune, when we reflect that sugar is a very fermentable substance. Everyone knows, for example, that starch is transformed

into a form of sugar before it is fermented in the manufacture of alcohol. How, then, does the sugar in the prune prevent the fermentation of the fruit and insure its preservation?

The answer is that sugar ferments only under influence of certain living micro-organisms, and that these micro-organisms cannot work in a too concentrated solution of sugar. There are myriads of the microbes spread broadcast everywhere on the wind, and of course they find lodgment on the skin of the prune as on every other exposed surface.

But the alkali bath to which the prune is subjected, destroys these germs at the same time that it cracks the skin of the fruit.

Other germs would find lodgment, however, and set up fermentation, were it not that the cracked skin permits a very rapid evaporation of the water content of the fruit. This quickly brings the sugar content to a degree of concentration that makes it a powerful antiseptic—that is to say a germicide that destroys any micro-organisms that enter it.

But unless the prune has at least 15 per cent of sugar in its pulp, it will take too long to desiccate it sufficiently to give the sugar the right degree of concentration. And unless the conditions are very exceptional, even when the plum has a sugar con-

tent of more than 20 per cent., it still will not dry rapidly enough to escape fermentation unless its skin cracks in just the right way.

A difference of the hundredth of an inch in the average interval between the cracks may make all the difference between a satisfactory prune and a nearly useless one.

Of course in the pure dry air of many regions of California, under a cloudless sky, a very sweet prune will often dry perfectly without the aid of the alkali bath; but it would not do for the prune raiser to depend upon these conditions as a general thing. He must control his prune, for he cannot control the weather.

Difficulties in Schooling the Prune

It is obvious, then, that the plant developer must always bear in mind the two particular features of the fruit's education he has to contend with.

But it is also understood that there are many other features that cannot be ignored.

A prune tree, like any other plum tree, must be a good grower and a full annual yielder. The fruit must ripen early in the season while the days are long and warm. It must drop from the tree in exactly the right stage of ripeness that the orchardist may not be put to the trouble and expense of picking it. The fruit should have a small stone

Prunes Drying on the Tree

A plum that has a sugar content sufficiently high to cause it to dry without decaying is legitimately called a prune. The one here shown appears to have that characteristic. But there is another quality which a good commercial prune must have—it must drop from the tree when ripe. So the clinging propensity of the prunes here shown is a fault that bars this particular variety from popularity.

and if possible a free stone—overlooking for the moment the question of entire stonelessness which will doubtless be required of the prune of the future.

Again, the trade demands a glossy black prune, for—owing, perhaps, to the fact that the French prunes, especially those cured in the smoke, are black—the average purchaser is prejudiced against the prune of lighter color even though it be of better quality.

When we consider how many of these traits are different from those required in the ordinary plum, and hence have been developed in recent times under conditions of artificial selection, it will be obvious how largely the task of the prune developer must be carried out in opposition to the main stream of heredity; and it will not seem strange that forty years has proved none too long a time in which to develop the perfect prune.

If I were to attempt to make a guess—it, of course, would be only that—as to the number of generations that have elapsed in the history of the prune since the qualities that chiefly characterize it were developed, my estimate would be something like this:

The tendency of the fruit to drop promptly at the right time has been in vogue for perhaps only five or ten generations out of the thousands of

generations since plums were brought under cultivation.

The quality of producing sufficient sugar in the right form for drying may have been developed during perhaps the last twenty-five generations; but it has been brought to its present high percentage during the most recent half dozen generations.

The condition of the skin which allows it to crack in just the right way has without doubt been cultivated for only a few generations.

But on the other hand the fairly edible flesh, not having a high sugar content, has been the heritage of the plum for thousands of generations.

So we can readily understand that the plant developer may secure among many thousands of seedlings, nearly all of them producing plums of fair quality, perhaps only one or two that show the qualities that specifically characterize the prune even in a minimum degree.

The progenitors of the seedlings may have been prunes of fair quality; but the seedlings themselves have gone back to the blanket stage of plum development.

The chances against securing even a single fruit that combines all the desired qualities among any given lot of seedlings are so small as to be almost disheartening.

Indeed when the plant developer brings

together two strains, each carrying its galaxies of more or less antagonistic characters, it is not altogether unlike scattering the letters of the alphabet in a whirlwind and expecting them to fall together in some chance eddy in such a way as to spell out some specified word.

Marking Progress

I was not unmindful of the difficulties of the project, but nevertheless the obvious need of a better prune than California growers had been able to secure by importation appealed to me from the time of my first coming to the state; and when I undertook plant experimentation on a large scale, the development of the prune was one of the things that first engaged my attention.

This work began about 1885, when I was growing seedlings of the European plum, *Prunus domestica,* from which practically all the prunes have been developed.

I have told in an earlier chapter of the success that ultimately attained the effort, through the development of the sugar prune. Here I wish to tell a little more at length of some of the tentative efforts and partial successes that paved the way for the final realization of an ideal.

As already told, I began experiments by hybridizing the French prune with the larger and handsomer but less sugary variety known as

Prune Tree in Blossom

A prolific bearing prune tree in blossoming time is almost a solid mass of flowers. The virility thus evidenced is a very desirable trait as it insures a full yield of fruit; but it is obvious that a tree that produces fruit in such superabundance will require attention in the way of thinning the fruit if the individual plums are to attain a reasonable size.

Pond's seedling, and in California often called the Hungarian prune. The little French prune was selected as the parent tree and many thousands of blossoms were pollenated from the Hungarian. This was in 1885.

Four years later, at the meeting of the California State Horticultural Society, I had the pleasure of exhibiting fruit of seventy different varieties of these crossbreed seedlings.

During the next winter a purchaser of the commercial part of my nurseries, being ignorant of the value of these crossbreed prunes, destroyed sixty or more of them. Fortunately, however, cions from several of the most promising had been grafted on older trees.

Among these selected grafts were two that gave much promise. These were advertised in *New Creations* of 1893.

The Giant Prune

In 1895 one of the new prunes was introduced as the Giant. It was so well received that four years later it was placed on the lists of fruits recognized by the American Pomological Society.

The Giant is a well balanced cross between its two parents the French prune (d'Agen) and the Hungarian. Fruits average 1½ to 2 ounces each and are of a sweeter and finer texture than the Hungarian but not so firm and sugary as the prune

Thinning a Prune Tree

In Mr. Burbank's orchards the superabundant fruit on the prune tree is shaken off by lightly tapping the branches with a piece of rubber hose adjusted on the end of a fish pole. This treatment does not injure the tree, and is particularly valuable for first thinning. It may be desirable subsequently to thin further by hand.

d'Agen. The large size, handsome appearance and rare keeping qualities place this among the best canning, shipping, and market fruits; but, unfortunately, the Giant follows its pollen parent the Hungarian in having a low percentage of sugar; so it does not cure well as a prune.

Here, then is a specific illustration of the tendency to revert to the characteristics of the plum and to give up the special qualities of the prune.

The Giant is a valuable fruit, excellent for shipping and especially good for canning. When placed in boiling water the skin immediately rolls away from the fruit, leaving the rich honey-colored flesh ready for the can.

The plum has made its way to distant territories, and is now grown extensively in Australia and New Zealand, being especially prized for canning purposes.

In California it has proved a favorite and it is greatly superior to its staminate parent the Hungarian prune, especially for shipment.

But it is sold as a plum and not as a prune.

The Pearl Prune

Obviously, then, this was not the fruit I was seeking. But my experiments continued and after a few more generations of crossing and selection, I found among the seedlings one that produced a fruit in many respects more promising.

This fruit was introduced in 1898 under the name of the Pearl prune.

The Pearl prune originated as a seedling from the French prune. It is usually a little larger than its parent, but somewhat more flattened in form. The skin and flesh are pale amber and so translucent when ripe that the stone can be seen through them.

It is really a delightful prune, of exceeding high flavor, delicious aroma, and melting flesh, surpassing even the true Green Gage plum. No prune excels it for attractive fragrance. When cured it produces one of the most delicious of prunes; but it requires care in handling, since it does not cure well in the open air. Its chief fault is that it is not very productive, although healthy and vigorous.

It was sold to a New Zealand firm for introduction in the Southern Hemisphere in 1898. I myself introduced it in the Northern Hemisphere.

The New Zealand nursery company recommends it for that country in a recent catalog as follows:

"Pearl:—Raised by Luther Burbank. A seedling of the well-known French prune, which it surpasses in size of fruit. It is very handsome, flattened ovoid in form, white, semi-transparent, with a heavy bloom. In honeyed sweetness, com-

A Typical Prune Cluster Before Thinning

It is obvious that there are more prunes here than can attain good size without injury to one another. Hence the necessity of thinning, one method of accomplishing which is shown in the preceding plates.

Prune Cluster After First Thinning

This is the same cluster of prunes shown in the preceding picture, after the cluster has been partially thinned by tapping with the rubber hose. The second, or hand thinning, will take place in a week or so, at which time one-third to one-half of the prunes here shown will be removed.

bined with a peculiarly attractive fragrance and flavor it excels all other prunes or plums. It requires care in handling, and will not cure well in the open air. It is especially recommended for market and home use when fresh."

The following quotation from "The Plums of New York," written in 1910, shows how this variety was regarded in New York at that time:

"The variety now under notice is one to be pleased with if it came as a chance out of thousands; its rich, golden color, large size, fine form, melting flesh, and sweet, luscious flavor place it among the best dessert plums. In the mind of the writer and of those who have assisted in describing the varieties for 'The Plums of New York,' it is unsurpassed in quality by any other plum. The tree-characters, however, do not correspond in desirability with those of the fruits. The trees, while of medium size, and seemingly as vigorous and healthy as any, are unproductive here. In none of the several years they have been fruiting at this Station have they borne a large crop. If elsewhere this defect does not show, the variety becomes at once one of great value.

"The fruits of Pearl are said to cure into delicious prunes—to be readily believed by one who has eaten the fresh fruits. This variety ought to be very generally tried by commercial plum-

growers and is recommended to all who grow fruit for pleasure."

Other Partial Successes

Another prune that I developed somewhat earlier was named the Honey prune.

This was one of my earlier seedlings and not a hybrid. It was of better quality and handsomer than the Green Gage, the standard of excellence at that time. The tree was not remarkably productive, but the variety has been welcomed as a home fruit in several localities of California. It was not considered worthy of general introduction but a few trees were sold to local growers who were interested in this variety and felt that it met the demands of their locality.

A seedling of the prune d'Agen which I called Miller, was sold to Leonard Coates of Morgan Hill California, in November, 1898. This he introduced in 1908 as the "Improved French Prune." Later the name was changed to "Morganhill."

The introduction of this prune as described by Mr. Coates himself furnishes an illustration of the length of time it usually takes for the public to become accustomed to a new fruit. In a letter Mr. Coates says:

"We did not attempt a system of advertising in the start but rather tested it thoroughly for some ten years or so. It is very hard to introduce any

Prune Drying in California

This is a typical scene in the California prune district. In the foreground are seen piles of racks not at present in use. In the background the racks, covered with prunes, are laid out on the ground while the fruit dries in the sun. Before drying, the fruit is sterilized and the skin properly cracked by dipping in a lye bath.

new fruit as so many have been put on the market without real merits. Fruit growers, however, appreciate to a considerable extent, the value of selecting good varieties of fruit to propagate from. It seems that the chief introduction of pedigreed stock has taken place since our present nurseries were located and advertised on letter heads, etc., as specializers in pedigreed stock.

"The Miller prune which we now call Morganhill has been coming under the head of pedigreed prunes. We called it in the first description 'Improved French.' Very few people had enterprise to buy these trees at any increased figure and now we are propagating them at the same price as any kind of prune tree. About half the people seem to ask for pedigreed prunes and the others simply say 'French prunes.' "

This, then, suggests a measure of success. It constituted at least a good beginning.

Successes more unqualified were to follow; but the work just described was instrumental in laying the foundation for the later improvements—improvements that culminated in four prunes, one of which is already revolutionizing an entire industry, while the others have intrinsic values at least as great.

An account of these perfected prunes will be given in the succeeding chapter.

Fruit of the Splendor Prune

Like the Giant prune, previously shown, this fruit is a cross between the French and Hungarian prune. It differs from the Giant, however, in having a much higher sugar content. The Splendor is of uniform oval shape, and the flesh is exceedingly sweet and black when cured—a great advantage. The fruit is so sweet that it requires little sugar when cooked, and it is of superior flavor. The stone is perfectly free. The one fault of the Splendor is that it tends to cling to the tree instead of dropping when ripe.

Four Burbank Prunes, and The Work Behind Them

Revolutionizing an Entire Industry

A BRIEF outline of the story of the sugar prune was given in a chapter of an earlier volume.

The preceding chapter gives further details of the quest of a perfect prune.

In the present chapter I wish to speak more of results than of methods, and to present somewhat in detail the characteristics and merits of the four nearly perfect prunes that have been produced as the result of my long quest.

While some of the details here presented appeal rather to the orchardist than to the general reader, yet the story as a whole will be found not without popular interest. The fact that the growing of prunes is an industry of great significance, and that the fruit is everywhere an important commercial product would furnish ample excuse, were excuse needed, for entering somewhat more into

detail as regards the specific qualities of my quartet of prunes than has been done in the case of most other of my plant developments.

The "Splendor" Prune

Another prune of the same parentage with the Giant (referred to in the preceding chapter), namely, the Hungarian prune, crossed with prune d'Agen, was advertised at the same time, under the number "A. P. 318" in *New Creations* of 1893. This was purchased by Stark Brothers of Louisiana, Missouri, who procured the entire stock for $3,000, and named it "Splendor."

This prune is very much larger than the common French prune, is oblong, has a rich violet-purple skin, and the flesh is exceedingly sweet, and black when cured—a great advantage. The American people have been educated to black prunes and generally prefer them to those of lighter colors, following the fashion set by the French smoke-dried prunes. The Splendor fully answers the desire on the part of the buyer and consumer for a "black" prune, of large size and superior quality.

Splendor prunes, when cooked, require little sugar, containing about five per cent. more sugar than the French prune, its quality and flavor are superior, and it has a perfectly free stone smaller than is usual with prunes.

Splendor Prune Graft in Blossom

This picture not only shows the admirable quality of stem of the Splendor prune, and its even distribution of blossoms, but it gives a good idea of a typical Burbank graft.

It ripens here two weeks earlier than the French prune.

The tree is even more productive, it is a more constant bearer, and is sturdier than its French parent. The tree is a well proportioned one, requiring but little pruning. The fruit is borne in clusters commencing low down on the body of the tree.

Many thought that this excellent prune would soon completely displace the prune d'Agen. Surely if quality and productiveness were all that were demanded by the grower, this would have occurred.

But Splendor has one peculiarity which places it at a serious disadvantage for general commercial purposes as a drying prune: the fruit clings to the tree when ripe, where it gradually dries into a delicious, sweet prune.

As prune growers like to have the prune fall as soon as ripe, to save trouble in harvesting, the clinging of the Splendor to the tree is considered a more or less serious fault. However, it is quite commonly planted wherever the German prune thrives, and gives excellent satisfaction, except for the extra trouble of picking.

It is shipped East as a fresh plum from sections of California in large quantities and is unusually well adapted to shipping, on account of its large

content of sugar, making a fruit which carries well.

The Sugar Prune

The Splendor was the best prune I had heretofore produced, but it clearly left much to be desired.

It was with intense satisfaction that I was able to offer, in *New Creations* of 1899, a prune that at least approached the realization of my ideal. This was another seedling of Petite d'Agen.

It was christened the Sugar prune.

For fourteen years I had labored to produce a large, early, productive, handsome, easily cured, richly flavored prune with a high percentage of sugar. The prize appeared in 1893, and by 1899 I had tested it sufficiently to warrant its introduction. Numerous growers had ordered $50 to $500 worth of wood for grafting—regardless of the quantity—even before grafting wood was offered.

I had worked diligently and unceasingly, watching for the slightest indication of variation in the direction desired. Finally through systematic crossing and careful selection, my cherished desires were realized—after years of persevering effort and patient waiting—in the Sugar prune.

In this, at last, I found a prune possessing the best qualities of all the prunes combined in one; and several of these qualities were intensified.

The Sugar prune had no rival until the advent of the still newer prune, the Standard, which I introduced in 1910.

When the selection of seedlings was made from which the Sugar prune originated, about one-half were at once discarded. Only those were saved which had the customary indications of good fruiting—large leaves, prominent buds, and strong, heavy wood with short joints.

Grafts from the young seedlings were placed upon Japanese plum stocks. This was done because there was no other stock at hand at that time. It proved to be a costly experiment, because more than half of these new, promising seedlings died before bearing fruit. Some of the grafts did not start at all; some made a short growth and died the first season; some grew a few seasons and died. Fortunately, however, some thrived as well as on their own roots.

The grafts that bore the first fruits of the prune which was later named "Sugar," made a fair but not a good union with the Japan plum. Although the first fruits of this variety were born on Japanese plum stock it is not recommended that Sugar prunes be grafted upon such stock. Roots of the Myrobolan plum make better stocks. Almond roots are also highly commended by some orchardists.

Fruits of the Sugar Prune

*With the Splendor **Prune**, previously shown, Mr. Burbank had produced a nearly perfect fruit; but the fault of clinging to the tree when ripe was one that had to be overcome, and this was accomplished after years of additional experiment. The fruit that retained the good qualities of the Splendor, and accentuated them, and which in addition had the quality of dropping from the tree when ripe was named the Sugar Prune.*

The seedling bearing the Sugar prune yielded its fruit the second year after grafting.

At that time I had the French Robe de Sergeant and German and Italian prunes growing on my Sebastopol place, and it was with these that the Sugar prune was compared. It proved to be superior in all respects to any of them.

Some of the fruits from the other grafts of this same lot of seedlings bore good plums but not good prunes. The fruits of the others had various faults, such as cracking, too large pit, clingstones, poor drying qualities, late ripening, scant foliage, or susceptibility to disease.

Several years are always required for the merits of a new fruit to gain full recognition, but the Sugar prune has gained pretty steadily in popularity. More and more growers are working their orchards into this variety, and it is taking the place it deserves, high among the leading prunes of commerce.

Besides this, it is proving to be one of the most acceptable fresh fruits in the eastern markets as well as extremely profitable when cured.

The growers at Vacaville, California, the most important early fruit shipping center, are becoming more enthusiastic as they see the fruiting of these trees, the ease with which the larger prunes can be harvested, and the greater price per ton.

About 2,500 new trees of this variety were planted in Vaca Valley in 1913.

Growers there received \$17 to \$25 per ton more for Sugar prunes in 1913 than for French prunes grown on the same farm at the same time. One of the growers reports that his French prunes averaged 57 to the pound last year—when cured—while his Sugar prunes averaged 39 per pound. The larger prunes always bring the best prices.

Not only did the Sugar prunes bring exceptional prices, the whole crop was dried perfectly, while the French and Imperial prunes, ripening later, were caught by the rains and many of them spoiled. The Imperial prune often dried to almost nothing but skin and stone.

One pound of green Sugar prunes makes seven and one half ounces of dry fruit. It contains six per cent. more sugar than the French prune and is far superior to it in flavor. It is so much more productive that it may be grown for less than half the cost of producing the French prune.

The Sugar prune has a great advantage over the other varieties in ripening early in August, three weeks before the French prune, and about a month earlier than the Imperial. It ripens at a time when the weather is hot and dry, so that it can be cured bright and glossy in a short time and before there is any danger from fall rains.

A month or so later, when the last of the older varieties are maturing, the weather is often cloudy and foggy, or sometimes even rainy and in any case the days are much shorter, so that curing is carried on under difficulties, often (as in the cases just cited) with serious loss.

In 1912, prune shippers estimated that rain damaged the crop of French prunes in this county twenty-five per cent. The Sugar prunes were all cured and packed before the rains, so there was no loss of this variety.

Progress of the Sugar Prune

The fruit of the Sugar prune is usually even in size and very large, averaging thirteen to fifteen to the pound fresh, which is at least three to four times as large as the French prune grown here under the same conditions.

It has excellent curing qualities, standing the lye bath better than most other prunes.

The tree is very far superior to the French prune tree in every respect; better grower, better bearer, better foliage, better form. It requires less careful but abundant pruning; and it will carry and mature more than double the quantity of fruit.

The wood is somewhat brittle, but the chief cause of the breaking of the limbs, which sometimes occurs, is prolific bearing. It must be

thinned when the fruit is about half grown, to prevent damage to the tree.

I have found that a very satisfactory and simple device for doing this is to tap the limbs gently with a piece of ordinary three-quarters inch rubber hose five to six inches long, fastened on the end of a cane or bamboo pole. The hose causes no injury to the branches, and, by striking just hard enough, the fruit can be made to fall evenly and leave the amount desired.

The need of thinning, however, may be largely obviated by proper winter pruning.

When this variety was first offered, grafting wood was sold at $10 per foot. That the investment was a profitable one even at that price is shown by the following quotation from a letter written by one of the first purchasers:

"I was one of the first to introduce this fine fruit into our locality, the first year the grafting wood was placed on the market. I bought seven feet of wood for $70. The same was grafted into Tragedy prune trees, using one bud for each cion. The following fall and winter I sold about $600 worth of buds and cions from the ten trees which I had grafted with the Sugar prune cions."

The Best Prune—the "Standard"

Pre-eminent as are the qualities of the Sugar prune, there is always room for improvement.

I endeavored to make such improvement by the usual method of crossbreeding.

About 1897 I combined the Sugar prune with the Tragedy. There were only twelve or fifteen seedlings from the cross. But these were carefully grafted upon older trees, on larger branches where they would be in less danger of injury. This, of course, made the bearing of fruit a year later than if they had been placed upon the smaller branches. But it seemed worth while to wait for fruits of such high promise.

The whole tree was given over to each of the seedlings. Nor was this exceptional solicitude unavailing. For among these carefully nurtured cions was one that bore a fruit that surpassed even the hitherto matchless Sugar prune.

After a period of trial, in which it met the severest tests, this superlative prune was introduced as the "Standard."

It is rather curious to record that, with a single exception, all the remaining cions of this patrician sisterhood have proved wholly worthless as prunes. But that, of course, was a matter of no consequence. It sufficed that one cion came to fruitage with the paragon of prunes.

The Standard prune surpasses the Sugar prune in quality. It also has a stone that is entirely free from the flesh, being the first prune ever produced

The Standard Prune

The Sugar Prune had no real rival until Mr. Burbank produced the remarkable fruit here shown. This is a cross between the Sugar prune and the Tragedy prune. It combines the good qualities of both parents, and it has the very important quality of being a freestone.

that combined superior qualities of flesh with this desirable characteristic.

In the opinion of a number of the best known growers, it is the best prune ever produced. The trees are enormous and never-failing bearers, and good, healthy growers, better than the French prune though not as strong as the Sugar.

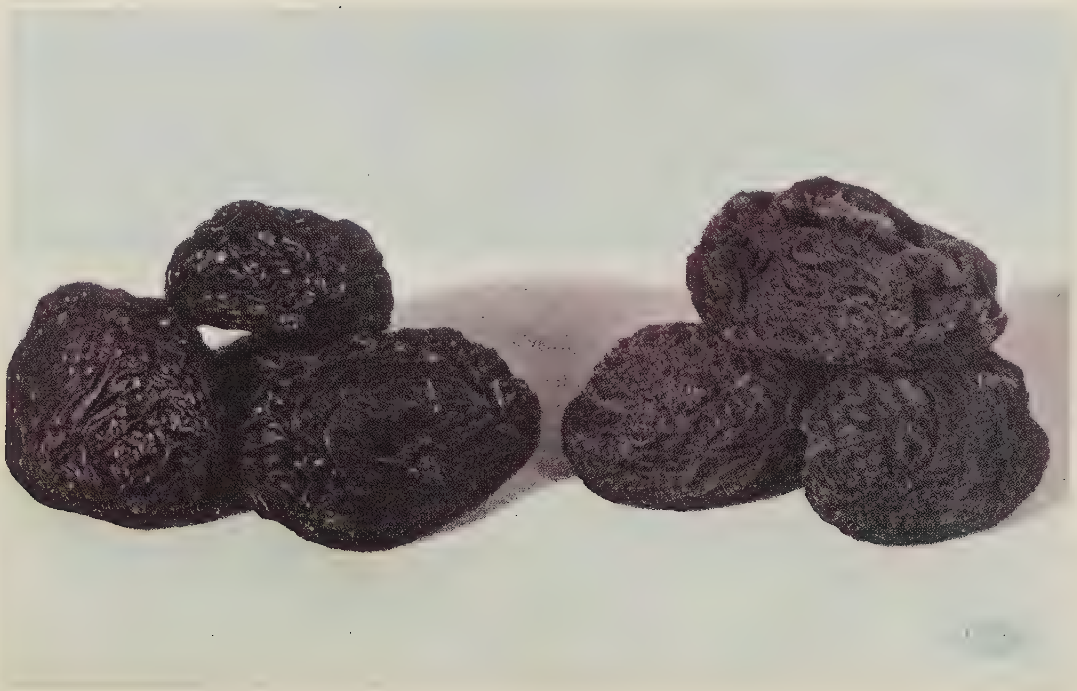
Well grown fruits measure nearly six inches around one way by four and a half inches the other.

On older standard orchard trees the size may average larger than this, and when the crop is not too heavy the fruits are really enormous.

The skin is purple with a heavy blue bloom; flesh honey-yellow, fine grained, juicy, yet firmer than most drying prunes, and very sweet. The stone, which is free, is only five-eighths of an inch in diameter.

Standard is without doubt the best combination drying and shipping prune ever produced. It ripens with the French prune in September. It has been kept fully a month in good condition in a basket in an ordinary living room during our warm fall weather. It can be successfully shipped after it becomes dead ripe, to any part of the United States.

And the final test as a prune is that when dipped in the ordinary lye solution the skin cracks



Sugar Prunes and Standard Prunes Compared

This picture shows the Sugar Prune at the left, and the Standard a. the right, after drying. These prunes are very large, and have many qualities to commend them. The Standard prune is slightly less sweet than the Sugar prune, but its important quality of freestone is greatly in its favor. All in all Mr. Burbank regards the Standard as the very best drying and shipping prune that has yet been produced.

properly, so that the result is a big, quickly-dried prune of superlative quality.

The following comparison of the French and Standard prunes, made by G. E. Colby of the University of California, gives a good idea of the value of the Standard prune:

	Average	
	The "Standard"	French Prune
Average weight in grams	49.7	23.6
Number per pound	9.1	19.1
Flesh, per cent	96.5	94.2
Pit, per cent	3.5	5.8
Sugar, per cent	18.9	18.5

In case any one wishes to change a prune orchard over to a more profitable variety, whether for drying or shipping fresh, I would strongly recommend the Standard for grafting.

The Standard was offered to orchardists in my catalog of 1911-12. The trees were sold at $3 each, and thousands of trees have been distributed, but it will be a good many years before the real value of this superior prune is fully appreciated.

Clingstone versus Freestone

The most striking individual peculiarity of the Standard prune is its freestone quality, already referred to. The development of this character is of such interest and importance that it calls for more than passing mention.

At first, it is very probable, all fruits were clingstones. The stone was probably firmly attached to the flesh from the time of the forming of the meat to the final decay of the fruit. The stone in fruit acts as a support to the flesh, to which it is attached and around which it grows.

The clingstone feature was evidently an advantage to the fruit, as plum and prune seeds will not germinate if thoroughly dried, and the clinging meat in most of the fruits keeps the seed moist for a longer time, thus helping to conserve its vitality until the proper season for germination.

Where the flesh is attached to the pit, the circulation between the pit and the surrounding flesh is less interrupted, probably an advantage to the development of both.

The clingstone is thus the more normal condition of fruits. Most fruits are clingstone until brought under cultivation. All fruits, both wild and cultivated, are clingstone until towards the time the ripening process commences.

That many cultivated fruits are freestone is no doubt the result of artificial selection to meet a very natural demand.

Nuts furnish analogies that help us to understand the relations of seed-stone and fruit. The case of the almond, which was perhaps more nearly the parent form of stone fruits, is particu-

larly instructive. In place of the rich surrounding meat which we see in peaches, apricots, and plums, the almond has a leathery skin, which is inedible. This generally clings to the stone persistently in the wilder forms, but with the best cultivated almonds the nut drops readily from the husk or outside covering.

Similar to the persistency with which the flesh of the plum clings to the stone is the attachment of the husk in the walnuts and the chestnut, in each of which the husk separates with more difficulty in the wild than in the best cultivated varieties.

From the standpoint of protection and reproduction of the almond, the clinging husk is an advantage rather than an objection. The seed of the almond will germinate after being thoroughly dried. It needs no flesh to tide it over, as do the pulpy stone fruits. But for men's use the clinging husk is a disadvantage, and the clingstone habit has been eliminated in all the best cultivated varieties of the almond.

In the plum a similar change has been developed by selection. The meat does not cling to the stone, in many cultivated varieties. In the almond the quality of the meat has been greatly improved, while the husk or immediate covering has not been improved in any respect, as no use is made of it.

The First Stoneless Prune

The reader is familiar with Mr. Burbank's wonderful experiments in producing stoneless plums by breeding from a partially stoneless French plum. In the same way attempts were made to produce a stoneless prune. The specimens here shown were the first that attained partial success. These prunes were stoneless, but were deficient in size and other qualities, and further experiments were necessary before a really valuable commercial stoneless prune was developed.

Even a freestone fruit does not start as a freestone, but the flesh tends to leave the stone as the fruit approaches maturity, very much as a leaf ripens away from its supporting stem in the fall when it has performed its annual function, or the fruit parts from the tree when it is fully ripe. The flesh parts from the stone by a natural process. This leaves the stone either "free" or partially free.

Some individual trees, among a lot of seedlings —chestnuts in particular—will hold their leaves persistently all winter (this persistence is especially common with crossbred chestnuts) even when thoroughly dead and dried, giving an untidy appearance to the tree, while the leaves of other seedlings fall at once and leave the branches clean and free.

This is a similar process to the parting of the flesh from the pit in fruits, both being ripening processes.

There is every gradation between the complete attachment we call "clingstone" and the "freestone" condition. In some fruits there is a single point of attachment; in others the flesh adheres over a part of the surface while the remainder may be wholly free from the stone.

There is also another form of partial separation found in some fruits where the flesh clings tenaciously to the stone until fully ripe, when it

Success at Last

After many discouragements, Mr. Burbank finally produced, through successive selections and recrossings, a nearly perfect stoneless prune, which was named the Conquest. It was the result of crossing a partially stoneless plum with the French prune. This fruit, as here shown, has the good qualities of the French prune, and yet is almost entirely stoneless. It was first brought out in Mr. Burbank's catalog of 1911-12.

parts readily, while in others it may separate from the fruit and be shaken about within it even before thoroughly ripe.

There seem to be two forms of variation, one in the time of attachment and the other in the persistency of attachment.

This persistency of attachment varies greatly; in some fruit it would be possible by a little work to cut around the stone and in others the flesh is attached so closely that to remove the stone satisfactorily you must have sharp tools and use them with discretion.

The old hereditary tendencies make it difficult to change plum and prune heredity so that it will produce freestones instead of clingstones. Nevertheless this has been accomplished with several varieties, including the Standard prune.

Of late the canners have preferred the clingstone peaches mostly, perhaps because they have a firmer flesh that does not fall to pieces when cooked, as the freestone peaches generally do. The pit is very easily removed with a sharp instrument made for the purpose. With this exception, fruits are generally more valuable when they are freestone.

The Conquest—A Stoneless Prune

But what if the fruit had no stone at all?

That would, indeed, be the ideal condition. And

The Conquest and Its Parents

In the background are four Conquest prunes; in the foreground is a cluster of small partially stoneless French plums known as the Sans Noyau. This was the original parent from which all stoneless plums and prunes were developed. The contrast in size between ancestors and descendants is strikingly shown; yet the Conquest is by no means the largest of Mr. Burbank's plums.

this ideal is met, or nearly met, in the fourth member of my quartet of best prunes—the Conquest.

This, the newest of my prunes, was first offered in the catalog of 1911-12.

The work of producing the stoneless prune parallels that of the production of the stoneless plum, a preliminary account of which has already been given, and fuller details as to which will appear in the succeeding chapter. Here it is necessary to mention only such aspects of the work as refer specifically to this prune.

The Conquest was produced by crossing a partially stoneless plum in my orchard with the French prune.

The difficulty of getting a stoneless prune was about equal to the difficulty of getting a satisfactory stoneless plum. If I had crossed with a plum it would have been a hundred times more difficult to get the prune characters than it was to get stonelessness.

In the Conquest the size and quality of the French prune is retained, together with the stonelessness of the other parent. This cross brought out both prunes and plums—some of the largest plums ever seen. At first they were all blue like the stoneless parent; later they took on all colors of ordinary plums.

Stoneless Beauties

These very sturdy and beautiful stoneless prunes have recently appeared in Mr. Burbank's orchards, but have not as yet been named or introduced. They are typical of numberless varieties that are under observation, some of which may lead to a better stoneless prune than the Conquest; others of which will never attain the honor of being named or introduced.

The advantages of the stoneless prune are too obvious to require elucidation.

To be sure, the new prune is not yet absolutely stoneless. A small speck still persists in prunes of best quality. It has been no great trouble to eliminate the stone in a poor fruit; to combine stonelessness with good quality of fruit has been extremely difficult. But continued selection will finally produce a prune of this kind which has the quality of the best French prunes, together with entire stonelessness.

By Way of Summary

Such, then, are the four Burbank prunes that are the pick of all those that have been developed on my experiment farms.

The methods used in their production are similar to those used in the development of the four best Burbank plums as told in an earlier chapter. The distinctive qualities of the four prunes themselves may be summarized thus:

The Splendor prune is large, productive, has high sugar content, has a small freestone and ripens early, yet has the fault of clinging to the tree.

The Sugar prune is large, productive, very early, superior in tree form, an especially good curer, and is both a sure bearer and a sure seller.

The Standard prune has most superior quality

of flesh, is entirely freestone, and in general is the best combination drying and shipping prune thus far produced.

The Conquest prune is similar to the French prune in quality of flesh, and has the stone brought down in size to a mere speck.

Because of the many characters it is necessary to combine in producing a successful prune, it is probable that the work represented by these four varieties is fully equal to the production of ten times that number of standard plums—with, probably, proportionate benefits.

But from the almost numberless varieties in my orchard, the result of years of selective breeding, there will probably arise individuals year by year that will present new and superior combinations of qualities; and among these may appear at any time a prune that will surpass my best prunes of the present as markedly as these surpass their predecessors of a generation ago.

This, indeed, is fully to be expected. Each of my prune trees, with its colony of selected hybrids, may be regarded as a factory admirably equipped for the turning out of new varieties of prunes. Even though it were left to be operated solely by the bees, its mechanism has been so perfected, its equipment is so complete, that it can scarcely fail of its purpose.

One of the First Stoneless Plums

This fruit represents partial success in the development of the stoneless plum. It resembles the original French Sans Noyau, its parent, in shape and general appearance, but is much larger and has an excellent flavor. It lacks some essentials, however, but was of service as a parent in further crossbreeding experiments that might lead to ultimate success.

Plums and Prunes Without Stones and Seeds

How All Fruits May Become Seedless

A NUMBER of years ago a distinguished pomologist who was not in the secret of my newest plant development, visited my place at Sebastopol in company with the eminent botanist Professor Hugo de Vries.

Standing by one of the plum trees, de Vries asked his friend to cut through a plum and examine the stone.

Then with obvious amusement he watched the pomologist work his knife carefully around the center of the plum—to avoid a stone that was not there.

As he told of it afterward, he declared that even the boots of the pomologist indicated surprise when the knife cut at last through the center of the plum without meeting any obstruction.

This was a case in which a man's surprise would be somewhat proportionate to his knowl-

edge of botany and plant physiology. The more he had studied the subject, the better he would be able to appreciate what stonelessness in a plum really means. The more he had worked in plant development, the fuller would be his appreciation of the labor represented in the reproduction of this anomaly.

And my visitor, being both a botanist and a practical plant experimenter, was certainly greatly surprised.

What the Stone Means to the Fruit

The story of the development of the stoneless plum has been told in an earlier chapter.

It will be recalled that I worked primarily with a small, partially stoneless plum that was found in France—a sour, acrid fruit of no interest except for its partial lack of seed-covering. I crossed this inedible fruit with a cultivated plum, and selected and re-crossed through successive generations, until I had segregated the characters of stonelessness and good quality of flesh and re-assembled them in a single individual.

Further mention of the development of the stoneless prune, through crossing the stoneless plum with the French prune, with the ultimate production of the Conquest prune, was given in the preceding chapter.

Here it is not necessary to repeat the details of

the method through which the stoneless plums of various kinds, including the prune, were developed. It seems desirable, however, to examine at some length the relations that obtain between the stony seed-covering and the general and especial needs of the plant; and to correlate this type of seed-covering with other types of protective seed-covering that serve the same or a similar function in the case of other tribes of plants.

When man takes a plant under his care, some of its many parts may become of little use, because of the changed conditions of the artificial environment.

Thus the wild oat has a pointed, saw-like beard, which, turning and twisting under influence of moisture and heat, helps the seed to burrow into the earth. This is obviously useful to the plant in a state of nature. But it becomes a useless piece of baggage when the plant has been tamed and grown by man, for man will see that the seed is planted, in return for the crop it yields.

The blackberry, domesticated, has no further use for the thorny armor that was originally developed to protect it from destruction by animals that would browse on its leaves and stems or trample it to death.

In the same way the cactus, when taken under cultivation, can dispense with the spines that were

so necessary a protection to it while it grew in the desert, where, in the old days, buffalo and antelope, and in more recent times cattle and horses would feed on its succulent slabs were they not carefully guarded.

The apple, which armed itself with sharp thorns when in the wild state, has given up the thorns since it came into the orchard.

Among other families of plants we find that protection has been secured by the development of acrid or astringent or poisonous properties, offensive odors, or imitative colors that serve no useful purpose except to safeguard the plant against its enemies. And such protective devices and mechanisms often become a burden when the plant is brought under the guardianship of man.

Of a piece with these protective devices is the peculiar covering that the plums and their allies have developed about the seed that grows at the heart of their fleshy and succulent fruit. This stone is like an armor-plate covering that successfully protects the seed from the action of even the strongest jaws, or from almost any forces of nature to which it is likely to be subjected.

Possibly one reason why the stone fruits have developed this unusual seed-covering is that each fruit of this family bears but a single seed. The many-seeded apple does not need to protect its

A Curious Fruit

This odd-shaped fruit is a cross between two stoneless plums. It has a large stone in the upper portion, with a hollow recess extending into the lower portion of the fruit. It is one of many interesting abnormalities observed in connection with the stoneless plum experiments.

seeds quite so jealously; but the plum, with its single seed, can afford to take no chances of the destruction of that seed.

The case illustrates a familiar principle of nature. Everywhere it is observed that the more prodigal the supply of reproductive mechanisms, the less the seeming care with which they are guarded. Among forest trees that are fertilized by the action of the wind, pollen is produced and wasted by the ton. But in flowers pollenated by insects, relatively small quantities of pollen are produced, and its distribution is carefully prepared for by the auxiliaries of color and fragrance and nectar which guide the pollen-distributing insects.

The mustard produces thousands of seeds for each plant, and it does not even take the trouble to imitate the grains of other plants, in size and form, as some of the seeds are obliged to do in order that they may be distributed with the grain when grown.

The peach, on the other hand, produces but a single seed for each flower and fruit, and armors that seed with so strong a covering as to make it difficult for the germinating cells to make their exit when the time comes for their development.

Thus these stone fruits conform to a great familiar principle of Nature. Their exceptional

covering has been developed by natural selection to insure continuance of the species under natural conditions.

But it is obvious that, now that man has taken the plant under his care, the species will be perpetuated with his aid, and hence the extraordinary armor about the seed might well be dispensed with. But as a matter of course the plant cannot drop all at once a structure that heredity and environment have worked thousands of years to build up.

Man cannot take the Indian and say to him: "Be civilized," and expect him in a generation to drop the tendencies that have become a part of him through centuries of inheritance.

The hunter cannot take the wolf and by treating him like a domesticated animal make a dog of him in a single generation—even though the ancestor of the dog was a wolf. And similarly when the fruit grower takes the plum under his protection, he cannot hope that this plant will give up at once the protective device that has served it so well in the long past.

Heredity will have its say, and the seed armor will persist long after it has ceased to be of real utility.

The Stone Becomes an Incumbrance

And yet it is easy to see, that under conditions

of artificial cultivation, the stone is not merely useless to the fruit; it is a positive incumbrance.

In the first place, it puts a tax upon the vitality of the plant—makes a strong draft on its energies. A plant is a manufactory for transforming elements of the soil and of the air, under the influence of sunlight, into grains, fruits, gums, essential oils, and the like.

Its capacity to produce any one of these is more or less complementary to its capacity to produce the others.

When the cultivated plum produces a useless stone, it has worked to no purpose; and the energy that goes to build the stone might far better have been utilized, even from the standpoint of the plant itself, in the production of fruit.

For the perpetuation of any given race of cultivated fruit plants now depend not upon the character of its seed-covering but upon the appeal made by the pulp of the fruit to the palate of man.

So the stone not only destroys a part of the usefulness of the plum for man directly, by its presence in the fruit, but it is also indirectly harmful in that it hampers the vigor of the tree in the production of foliage and larger quantities of fruit.

Yet when the plant improver attempts to remove the stone that has thus come to be an in-

Not So Good As They Look

The plum here shown was absolutely stoneless, but it was found to be too hard and too bitter to eat. Its only value was as a parent in further breeding experiments, in which the quality of stonelessness could be retained while good qualities of flesh were introduced. It will be understood that a plum may be altogether stoneless and yet retain a kernel that is viable.

cumbrance to the plant, he is obliged, as it were, to swim upstream against the hereditary current of the ages. Ten, fifteen, twenty years—these are but moments of time when working against tendencies that are fixed by thousands of repetitions under conditions that remained unchanged for numberless generations, and until the immediate present.

Bearing this in mind, we gain a more vivid impression of the difficulties that confront the plant developer who would endeavor to relieve the plum of its burdensome stone.

Aid From Nature

But here as elsewhere Nature will sometimes seem to forget for a moment the very fundamentals of her plan; and through such a lapse the hereditary mechanism of a given organism may be changed more radically, perhaps, in a single generation, than it could be changed by almost any number of generations of selective effort on the part of man.

Such a lapse was made, we do not know just when, in the case of a minor variety of plum that chanced to grow in Central Europe. Through this momentary lapse in Nature's memory, this plant found itself with a seed for which the customary stony covering had been nearly half forgotten. Only about half remained of the shell

that to plum seeds in general is as a veritable armor plate.

The plant that suffered this strange mishap was, as the reader already knows, a little French bullace of small significance, known as the *sans noyau*. Of course we must not be supposed to imply that the relative importance of this particular member of the plum tribe had anything to do with its mishap. The laws of heredity apply quite as rigidly to the most insignificant as to the most important of plants. Indeed, it is scarcely within man's province to decide as to which plants are really insignificant and which important in the scheme of things.

But at least it may be affirmed that, according to ordinary human standards, the little bullace was of most inferior type. Yet, paradoxically enough, it became, in virtue of its misfortune, the most important race of plums in the world.

For without the aid of this seemingly malformed race, the plant developer would have had no leverage with which to attack the problem of relieving the great family of stone fruits of their now useless and even obnoxious seed-covering.

The malformation of the little bullace, through which it lost its seed protector, would doubtless have resulted under conditions of natural selection in exterminating the species.

But the same transformation which would thus have worked destruction in a state of nature, sufficed to make sure that, under the changed conditions of artificial selection, this particular plum should become the progenitor of all the plums of the future.

For we can little doubt, now that the stone has been taken from a few varieties of cultivated plums and prunes, that all other varieties will ultimately be brought into the stoneless coalition. And the only feasible way to bring this about will be to interbreed one variety after another with the descendants of the little stoneless bullace.

The plums of the future will be diversified in form and size and quality.

They will draw their chief ancestral traits from the plums of Japan or China or Europe or America, or from a blending of these strains.

But each and every one of them will have the little *sans noyau* for one of its ancestors, and will owe to that plebeian ancestor the quality of stonelessness which will be regarded as one of its best prized characteristics.

A Retrospective Glance

In this view, then, the stoneless plum may be considered perhaps the most interesting of fruits.

Possibly a future even more important than that just suggested may be in wait for it. It is at

Stoneless Anomalies

This picture shows the variant results of crossing two stoneless varieties. At the left is an entirely stoneless fruit in which the flesh is very soft; at the right, another fruit of similar parentage in which the flesh is tough and sinew-like, forming a net-work—as if Nature were endeavoring to make up for the loss of the stone, by providing a protective tissue.

least within the possibilities, as hinted in our discussion of the peach, that the quality of stonelessness may be extended from the plums to the allied tribes of stone fruits by hybridization.

Conceivably the descendants of the little bullace may include not only the races of cultivated plums but even all races of apricots and plumcots and cherries as well.

But even though the view be confined to much narrower limits, it still remains true that the stoneless plum is among the most important of plant developments. So it may be worth while even at the risk of a certain amount of repetition to review the history of this development, and in particular to add a few details that have not hitherto been presented.

It will be recalled that the little *sans noyau,* despite its name, was not altogether stoneless, inasmuch as each fruit had a rim of stone more than half way around the kernel; also that the fruit itself was only about the size of the ordinary cranberry, and was harsh, acrid, and unpalatable.

Yet when this unpromising fruit was crossed with the French prune, and with numerous other plums and prunes, some of the crossbred seedlings produced fruit larger than the French prune, and nearly all of the hybrids were superior to the wild parent.

Small but Luscious

These dainty and delicious fruits are almost altogether stoneless. Their quality of stonelessness and their excellent flavor highly commend them, but they are lacking in size, and have not been introduced.

All the seeds of these hybrids were carefully saved and planted. The seedlings were grafted on older trees, and a few seasons later still better ones were obtained; plants bearing larger fruits and many of them showing the tendency to abandon the stone.

The first generation hybrid seedlings of this type, which were quite numerous, had mostly the French prune for the pistillate parent. A good many, however, were from the reciprocal cross.

Of the latter, the crooked thorny seedlings which indicated that they were not crossed, or had reverted to the wild type, were generally destroyed even if they bore stoneless fruit. Those which showed the French prune or ordinary plum type were grafted into older trees to bear.

All the seedlings from the cross of the *sans noyau* pollen upon the French prune were grafted and fruited even though many of them exhibited the thorny, dwarf, ill-shape of the wild parent.

After the first generation the seeds of all were mixed, as there seemed no object in keeping them separate. For two or three generations there were all sorts of trees, the greater tendency being towards the bullace, which, being a wild type, would naturally be expected to have its characters more thoroughly fixed.

In the first generation some plums were ob-

Large and Luscious

This stoneless plum has distinction among the numberless others that have appeared in recent years in Mr. Burbank's orchards. It has good size in addition to its other qualities, and ultimately it will probably make a name for itself in the market.

tained fully twice as large as the fruit even of the cultivated parent. But most of these had stones, and were, moreover, soft, sour, undesirable fruits.

All but a few of the more promising grafts were removed from the trees, and the experiment was continued with the selected ones.

In the next generation there was some general improvement in the growth of the seedlings and the size and quality of the fruit. And in later generations the quality of the fruit rapidly improved—combined with stonelessness—until I obtained two or three fine plums and prunes.

These were grafted extensively and seedlings raised and selected for still further improvement.

Some of the earlier results of these experiments were exhibited at the Pan-American Exposition at Buffalo, New York, in 1901, and aroused much interest among fruit growers. None of these, however, was worthy of introduction as a commercial fruit.

The plum called Miracle was the first of the stoneless plums to be introduced.

This is borne on a rather slow-growing tree and has the size, flavor and appearance of a small Damson, being about an even balance between the French prune and the original *sans noyau* in most of its characters. Some years it is quite productive, but it is not an altogether dependable bearer.

A representative of the Oregon Nursery Company, on a visit to my Sebastopol grounds in 1903, was greatly pleased with this variety, and at once purchased it. It has been advertised and grown quite extensively. Its flesh is of such quality as to be chiefly valuable for the making of jam.

At that time it was the best stoneless plum in existence. But its chief merit was that it was the forerunner of a race of stoneless plums and prunes which will in time be grown wherever these fruits are raised.

The Stoneless Prune

The next stoneless variety to be introduced was the prune named the Conquest, with which we have already made acquaintance. It will be recalled that this is one of the quartette of best prunes described in the preceding chapter.

From three per cent. to six per cent. of the bulk of the French prune is stone. The specks of stone that remain in the Conquest do not constitute more than one-thousandth part of the fruit, which is thus edible practically without waste.

The Conquest was offered in my catalog of 1911-12 with the following description:

"There has been known for several hundred years a wild plum, an unproductive, thorny bush, which bore insignificant, acid, bitter, wild berry-like fruits with only half or two-thirds of a stone.

Years ago it was hunted up in Europe with the plan in view of producing really valuable stoneless plums and prunes. The labor and expense incurred in these experiments have been enormous, but among the many thousand varieties, one really good stoneless prune was produced and is here offered for the first time in the history of this earth.

"The tree is a vigorous, healthy, rapid grower and unusually productive. The fruit is very similar to its civilized parent, the common French prune, in form, size, color and golden, sweet, rich flesh. The stone has been eliminated wholly with the exception of a tiny speck. The fruit is so very valuable and the tree so very productive that I have consented to introduce it this season. It ripens with the common French prune and is in all respects very much like it in size, quality and appearance."

The French prune is nearly oval but Conquest is slightly more flattened in form, like some of the German prunes.

Further Improvement in Prospect

Among the later seedlings I found some very good fruits which have reverted to the stony type, one of them in particular being extremely large and of sweet, rich, superior quality.

Thus, after several generations of plums with-

Striking Contrasts

The picture shows a blue stoneless plum growing on the same tree with the Barnblood plum—the result, of course, of a grafting experiment, in which the Barnblood tree was the stock. Such anomalies are common enough in Mr. Burbank's orchard, but are always interesting.

out stones, those having ordinary stones again appear. There are others, however, that retain the stoneless condition, and are of exceptional size. Every color of the plum now appears in these stoneless hybrids—white, pale yellow, orange, scarlet, crimson, violet, deep blue, almost black, striped, spotted, variegated, and mottled in every way imaginable.

They ripen from the middle of June until Thanksgiving, and while some varieties are no larger than a cranberry, others are larger than any other plum now generally cultivated, except perhaps the Climax, the Wickson, and Kelsey.

After a time, no doubt, varieties may be produced with solid flesh throughout, as many seedlings now have indications of such a condition. The best stoneless plum thus far produced has a strong tendency towards this condition.

I am often asked how the present plum with stones and seed will be replaced by the stoneless variety.

Will the ordinary varieties be supplanted within a few years?

There is no probability of that. It will be a long time before our present orchards are replaced by trees bearing stoneless fruit. Long years of selective breeding have been required to give the plum its good qualities. To hold to present

Stoneless but Unmarketable

This unnamed stoneless seedling gave great promise, but its flesh proved to be so soft that it has no commercial value. It would have merits, however, as a plum to raise in the dooryard for home consumption.

standards of quality and make the fruit stoneless as well, will require a great amount of time, patience and effort.

Of course, with modern methods it can be done in a much shorter time than in the past, but it must take a long time gradually to replace one and then another and another.

The replacement of the ordinary plum by the stoneless plum will come about gradually, somewhat as the red potato was replaced by the white potato in California. Twenty-five years ago nothing but the red potato could be obtained in any of the markets of this state. Even my own brothers questioned whether the Burbank could make headway against it. To-day the Early Rose and a few other varieties may be secured when the Burbank is out of season.

The Outlook for Seedless Fruits

It will be remembered that there have been seedless raisins grown for a century or more, yet everyone knows that seedless grapes are by no means universal.

The well known Washington navel seedless orange has made a new world market for this fruit. Yet the bulk of the oranges in the markets of the world have seeds. There are good seedless lemons and limes; but they are very gradually finding their way into the markets.

Absolutely Stoneless

This still unnamed seedling is absolutely stoneless, and the kernel is somewhat enlarged, so that it almost completely fills the cavity. Although this particular variety may not be introduced, it will almost certainly become the progenitor of commercial varieties of stoneless plums.

The change from stone to stoneless fruit will come about by imperceptible steps. The change will be so slow as hardly to be noticeable. Poorer varieties of all fruits are gradually replaced by the better; so gradually that the change is scarcely noticed.

Odd forms are constantly coming up in nature —like the little, deformed bullace that was the parent of the new stoneless plums. Sometimes their inherent prospective value is recognized—oftener not. A hornless animal appeared as a sport or sudden variation in Argentina half a century or so ago. Possibly this freak may have appeared a hundred times before. But in this instance someone having imagination noticed the mutant and fostered it, and we now have hornless stock from that Argentine variation, not only of the original but of nearly all breeds.

Among fruits, changes no less marked are constantly arising, and as time goes on these will be more and more recognized, and appreciated and used. As a greater knowledge of plant improvement is becoming disseminated, more pronounced changes for the better will be made—the elimination of stones and seeds being one of the most important of the many improvements required.

The appearance of the stoneless plum, not as a chance sport but as the product of an arduous

series of hybridizing experiments, may be taken as a sure augury that the conception of an age of stoneless fruits is not illusory—however long its coming may be delayed.

—Man cannot take the Indian and say to him: "Be civilized" and expect him in a generation to drop the tendencies that have become a part of him through centuries of inheritance.

The Gee Whiz Plum in Bloom

The plum to which the rather startling name, "Gee Whiz," has been given is a complex hybrid. Like many hybrids, it shows great virility, illustrated by the habit of blooming and bearing to the very tips of the limbs. The distribution of blossoms on the tree here shown is practically ideal.

Planning an Ideal Plum or Prune

The Requirements and How They May Be Met

WHEN I was in the nursery business a man came to me on one occasion and wanted trees for his orchard. I showed him my stock, but it did not suit him. He wanted trees that grew six feet high before branching. I had nothing answering that description, so he bought elsewhere.

In a year or two his trees were sweeping the ground, quite as might have been expected. So the orchardist came to me to find out what he should do.

Naturally I told him he should have commenced right by getting trees of the right form at the outset. Now there was nothing for him to do but to cut his trees back to the right height, and let them start anew, thus losing two years of growth. He did not like this prescription, but he presently had to follow it. Of course his trees

were never as good as though they had been given the right start; but their new condition was an improvement on the old one.

This misguided orchardist was simply acting on the mistaken idea that was everywhere current until quite recently—the idea that it is necessary to run a tree into the sky so that other crops can be raised under it, and that teams can be driven close to the trees in cultivating. Nowadays the orchardist adapts the implements of cultivation to the tree, instead of adapting the tree to the implements.

Or, what is better, he adapts the trees to the land and makes the orchard pay better and with less labor, without attempting to raise any other crops in the orchard.

It has been discovered that skyscrapers in the orchard do not pay. A tree should be of such form that the fruit may be picked conveniently. It should not be necessary to use step-ladders to gather the fruit from the lower branches.

In the case of the prune, in particular, a low-branching tree is especially to be desired, that the prunes may not get bruised in falling for even as tough a fruit as a prune may be injured in falling from a tall tree.

Planning the Plum Orchard

The old way of planning an orchard was to

look over a catalog and order half a dozen of this or half a dozen of that, without asking any questions or gaining information as to whether the varieties selected were adapted to the region where they were to be grown.

And the old way for the grower or nursery man was to accept the form of the tree as it tended to grow, with little or no attempt to change it.

But the new way is for the intending orchardist to select his varieties with the utmost care, paying careful heed to questions of soil and climate, and introducing only such fruits as are adapted to the conditions that must be met. And as to the trees themselves, when they begin to grow, the modern plant improver is by no means content to leave everything to Nature. He takes a hand from the outset, and largely determines the form of the tree.

Moreover, the up-to-date orchardist will look beyond the existing variety, and recognize that it requires both imagination and labor to produce the ideal tree.

Building an ideal plant of any kind is like building a house. Each must be planned in accordance with a clearly conceived idea. But there is this great difference: In the case of the plant you must wait for Nature to supply you with the material with which to build.

Plant building is architecture—but architecture with limitations. It is always slow and very often it is extremely disappointing, yet it has its encouraging surprises as well. Times without number I have been ready to give up an attempt to secure an improvement on which I had worked unsuccessfully for years, when, just as my patience was at the breaking point, Nature would seem to have a generous mood and, as it were, throw the desired characteristic into my lap.

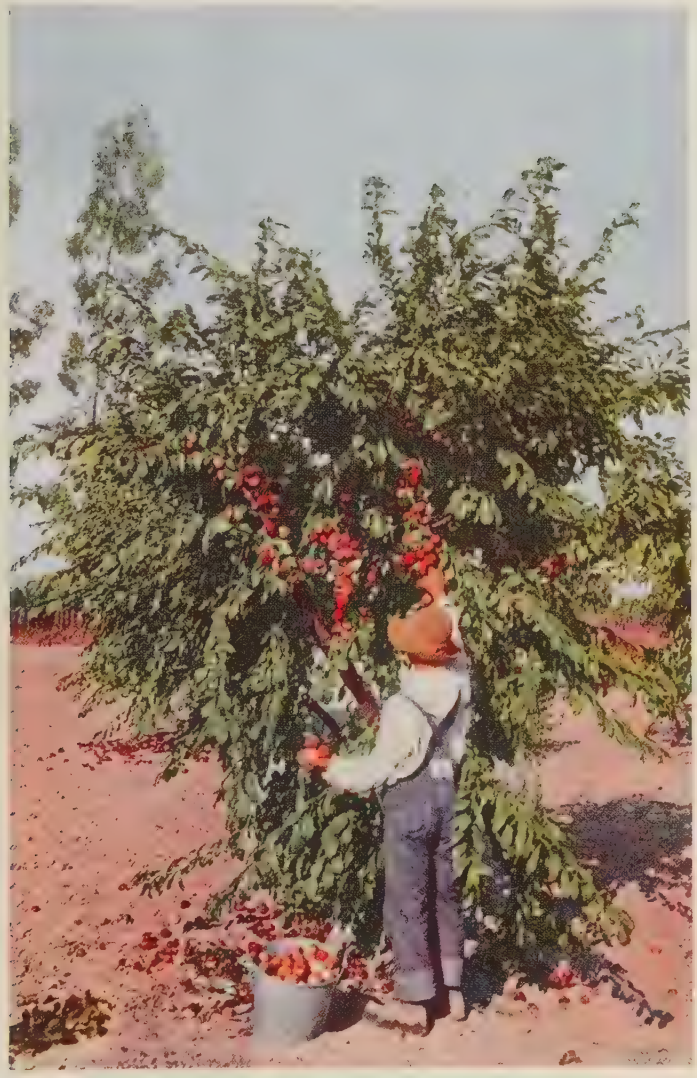
What the blue print means to the architect, the conception of the tree or fruit or flower wanted should mean to the plant improver. It represents a precise ideal toward which to work, and it gives standards of comparison by which progress may be checked as the work progresses.

In the case of the plum, it is possible to present the ideal to the mind with great accuracy. Of course it may not be possible to attain results strictly in accordance with the plan. But usually the ideal may be at least approximated if it has been intelligently conceived, and if it is persistently borne in mind.

Specifications for an Ideal Plum

Let us now note specifically and in sequence some of the practical points to be considered in planning our ideal plum.

In so doing we shall find that there is a certain



An Ideal Plum Tree

The modern fruit tree has been taught to assume a low rounded form, bearing its treasures within easy reach of the picker. In the tree here shown, the results of first thinning with the rubber hose are seen on the ground, and the second thinning is being performed by a boy who is able to reach most of the clusters without the aid of a stepladder.

amount of overlapping, or perhaps we had best say interference, of qualities. A plum that is best for one purpose may not be best for another. We must bear in mind the different purposes to which a plum is put, and endeavor to make our plan comprehensive enough to cover all of them.

There are certain qualities, to be sure, that are desirable in every variety of fruit. Large size, for example, and frost-resisting quality are seldom or never disadvantageous. Yet even this must be qualified, for, in case of a prune, drying becomes more difficult as the fruit enlarges, and unusual size may be a disadvantage. But for plums in general we aim at a tolerably definite combination of qualities—size, form, color, flavor and hardiness—and endeavor to associate these in the same fruit.

Taking up our ideal plum tree part by part, let us first consider the root.

This is of great importance. A great difficulty of the French prune is that its root system is ordinarily inadequate. It is usually necessary to graft this prune on other roots. Peach stock is sometimes used to advantage both for this and for other varieties of plum. But there are some plums that do not graft kindly on the peach, and it is necessary in such cases to make a double graft, using first a cion of some plum that grafts well

Spur Bearing

Clusters of seedling plums often grow close to the trunk of the tree, as in the case here shown. It is interesting to note that in this specimen the broad, healthy leaves indicate good fruit-bearing capacity, and the beautiful clusters of plums show the justice of the prediction.

on the peach, and then grafting on this the cion of the desired variety.

This is obviously a rather tedious procedure. Fortunately it has been discovered that the Myrobolan plum furnishes good roots on which almost all plums may be grafted, and this stock is becoming very popular. The roots of the apricot are also sometimes used successfully. On deep, dry soil, almond stock often gives the best results.

But, of course, there will be great advantage if the plum can be made to grow a good set of roots of its own. It should be recalled that an abundance of roots is always closely correlated with abundance of foliage. One may tell at once in the orchard whether a tree has a good set of roots by observation of the foliage. And the close dependence of the roots on the foliage is a matter of common observation.

Many orchardists fail to realize how completely the roots are governed by the amount of foliage. And even when this is realized the observed conditions are not always correctly interpreted. If the foliage did not govern the roots, our orchard trees would be of all sizes and of all degrees of vigor, whereas now, when grafted on seedlings of varying degrees of vigor, the trees are uniform.

As to the stem of the tree, this should come up straight as a flag-staff, and should branch sturdily,

Skin Texture

The texture of the skin may have a very important bearing on the commercial value of a fruit. At the left is shown a plum with very thick skin, which will withstand shipping; at the right, a thin-skinned fruit, which may be valuable for home consumption, but which cannot be sent to distant markets.

the branches coming out not quite at right angles but turning slightly upward. Branches should not turn down, nor should they be crooked. Moreover, the branches should not tend to grow too long and slender.

Many seedlings tend to take on a bushy growth, which is undesirable. Others are too slender. Some have a general irregularity of growth, which is particularly objectionable. Brushiness invariably indicates a lack of production; it suggests a reversion to some inferior ancestral type. And it may fairly be predicted that the tree will show similar reversion as to fruit, producing a small fruit of poor quality.

Brushiness is indicated by slender, too abundant, poor branches instead of sturdy branches. Slender branches can never be correlative with large fruit—they have not requisite strength.

That is one of the many reasons why I select seedlings with large branches, and those having prominent buds and large, thick leaves. These are all indications of a bearer of large fruit.

Large branches and large fruit are associated together through the effect of past heredity; just as, contrariwise, small fruit and small leaves and branches are the hereditary traits that are similarly associated with small fruit.

Of course, it is not always possible, in the

A Practically Perfect Plum Tree

This tree has perhaps been allowed to run up a little too high, and its branches have not been quite adequately thinned; yet on the whole it may be said to represent a practically perfect type of plum tree. Note the wide horizontal spread, bringing the main bulk of the fruit within reach of the picker when standing on the ground.

present stage of orchard development, to secure a tree of perfect growth and form.

This is true not alone of plums but of other orchard fruits. Some of our best varieties of orchard trees, like the Bartlett pear, have branches too slender and upright, and do not carry the fruit well. The Bellflower, though a fine apple, makes a weeping growth. The Newtown pippin makes too slender and upright a growth. On the other hand, the Gravenstein apple makes a very fine, spreading tree, and the popularity of this variety may be to some extent associated with the almost perfect form of the tree itself.

But it is one thing to observe that a tree is imperfect, and quite another thing to take the trouble to improve it.

We know that the branch system should resemble a vase in form, avoiding brushiness, woodiness, or overgrowth. But many orchardists who are well aware of this will not take the trouble to prune the tree in such a way as to encourage this development; nor will they consider the matter of selecting a variety that tends to grow in the right way without pruning.

As to the leaf system, it is always desirable that the foliage of a fruit tree should be large, thick and abundant.

In the case of cherries it is particularly desir-

Ideal Foliage

The foliage of the central tree indicates a vegetative and digestive system in first class condition. Such a tree, with its large, abundant foliage, may safely be selected for the production of a fine quality of fruit. As we have already seen, this selection may be made when the seedling is still a small plant; the future tree will almost surely live up to expectations, based on its foliage.

able that the leaves should hang over the fruit to protect it from the weather and from birds. With the plum this is not so necessary. Still the question of foliage should always be considered. Other things being equal, seedlings should be selected that show large, thick leaves.

Blossoms and Fruiting

It is almost axiomatic to say that plum seedlings should bear perfect blossoms in reasonable abundance.

The blossoms should be borne on the larger wood of the tree rather than on the tips, because the fruit is held better where it has the support of the older wood. Moreover, if the fruit is borne at the tips of the branches, these are brought too near the ground.

The time of flowering should be given careful consideration in connection with the climate where your orchard is located. Many fruit trees bloom so early that in mild climates the late spring frosts injure them. In general, late-blossoming trees have an important advantage.

It should be understood that a tree that blossoms late usually matures its fruit early, whereas one that blossoms early will usually bear late fruit. This is, of course, precisely the reverse of what might be expected, unless we bear in mind the reasons for the difference. A moment's re-

Protective Foliage

Protection from birds and from the elements is a very important item with many fruits, notably the cherries, but including also many plums. This picture illustrates how vigorous foliage may give a large measure of protection to a cluster of plums. This picture was taken from above. Compare with the succeeding picture.

flection makes it clear that late bearing and early fruiting should be correlative, being adaptations to a climate where the summer is brief.

The bearing season of the plum may be short or long according to the use to which the fruit is to be put.

Fruit that is to be gathered wholesale for the market should have a short season, the major part of it ripening at the same time. On the other hand, fruit for home use or a local market should have a long season.

But even more important is the matter of "every year bearing." A tree that never makes a failure—one that bears annually and does not have any off years—is the kind of a tree that is needed. The orchardist naturally wants a tree that can be depended upon to give him a crop. A tree that sometimes balks after starting a lot of fruit, because the temperature or conditions of moisture are not just to its liking, is not the kind of tree that endears itself to the fruit grower.

It must be understood, however, that fullness of bearing has no necessary association with hardiness. The two qualities are quite distinct. A tree may have one quality and quite lack the other. It may be able to thrive under adverse conditions but not to bear under adverse conditions.

The ideal tree, of course, is one that will not

Foliage Protection Further Illustrated

This is the same cluster of plums shown in the preceding picture, but in this case the camera was adjusted below. Here are three plums that were totally invisible from above, and two that were only partially visible. The value of such protection from sun and elements is obvious.

only thrive but will invariably produce a fair crop of fruit whether the season is hot or cold, dry or rainy. A fine practical test of fullness of bearing is supplied when a frost comes just after the blossoms have dropped, while the miniature fruit is fully exposed.

A tree that will stand this test may generally be depended on as an every-year bearer.

Nowadays the plant developer has this matter of every-year bearing in mind, and varieties of plums have been developed which conform to this business principle. Our fathers pretty generally supposed that a fruit failure about every second or third season was to be expected. Now we know that the right variety of fruit can be depended on to give a crop each season.

In selecting stock for your prospective plum orchard, bear this point very carefully in mind, and choose only such varieties as have the inherent tendency to bear fruit with regularity.

Size and Quality of Fruit

It was just noted that a prune may be so large that it dries badly. This is not likely to be the case, however, if the prune ripens early and has a high sugar content. And as to plums in general, large size is, of course, a foremost merit.

There are other fruits that sometimes tend to grow too large. This is true of certain pears; also

An Ideal Root System

The photograph shows a yearling plum, having sturdy, well branching root system that will provide, in suitable soil, sufficient nourishment for the plant above it. The reciprocal relation between root system and leaf system should be clearly understood by every orchardist.

of some peaches. But the plum has not as yet been developed to anything like the maximum size, notwithstanding the very great improvement of recent years. A good many of my newer plums are giants in comparison with the standard plums of a generation ago. But no one complains that they are too large. On the contrary, their high price in the market is due in considerable measure to their large size.

In selecting the ideal plum there is no reason nowadays why you should not secure one that bears fruit that is at least two inches in diameter on the average.

In form the plum should approach the globular. This is best in most fruits, for the reason that the spherical form is the most compact, and therefore the one best adapted to handling and packing.

The suture in the plum is a mark of recognition, but of no value to the fruit in any way. It is mostly due to the fact that one side of the plum grows slightly larger than the other. But this is a matter that concerns the pomologist rather than the fruit originator or grower.

The same is true of the ridge on the plum stone. It is a mark often used as a distinguishing character between different varieties, but which has no practical significance.

The plum should be of some attractive color,

Progressive Ripening

This cluster of Giant Maritima plums has one fruit nearly ripe, one nearly green, and two in intermediate stages. Such uneven ripening is a fault in a shipping fruit, but it may be a merit in a fruit for home consumption, greatly lengthening the fruit season.

red, yellow, or even a brilliant white. Green fruit is never attractive. It would appear that the birds and man have combined forces to produce red and yellow fruits by selection, because these colors are enticing, and we have come to associate them with superior qualities of fruit.

The skin of the plum should be thick and firm, especially if the fruit is to be shipped to a distant market.

For home use or a nearby market a thin-skinned plum may be quite as satisfactory.

The bloom of the plum adds to its appearance, and its condition may be a test of freshness. The bloom evidently had originally a protective function, possibly shielding the fruit from the sun, or otherwise protecting the juices from too rapid chemical change.

The bloom may be developed on a fruit by means of selection where it is especially desired for any reason. It is obviously only a minor characteristic of the perfect plum.

The flesh of the plum should be firm, particularly if the fruit is to be used for shipping purposes. The texture may be shown by cutting the fruit with a dull knife. For home consumption, plums that are very watery are often considered a great treat. I have some splendid watery plums now growing—fruits that almost melt in the hand.

Ideal Form and Bloom

This is Mr. Burbank's famous Combination plum, a fruit so named because of the large number of divergent ancestral strains that are represented in its heritage. These plums have an almost ideal globular form, with a thick bloom evenly distributed, so that it affords protection to the fruit everywhere.

But these have not the texture to stand the trip to market and keep in good condition.

The orchardist must bear this difference clearly in mind, and let the choice be determined by the use for which the fruit is intended.

Nearly white is usually the most suitable color for the flesh of the fruit. Yellow flesh is also admissible, and sometimes pink or crimson. The plums with crimson flesh, as we have elsewhere learned, are all descendants from the Satsuma plum which was one of my earliest importations from Japan.

Plums show almost every possible combination of flavors. Appearances are sometimes deceptive as to the eating qualities of the fruit.

As an instance, one plum that I have named the "Fraud" is extremely beautiful to look at, but its flavor is that of vinegar. There is, of course, a great range of variation between different plums—even aside from those that rank as prunes—in the matter of sugar-content. Some are very sour and require a great deal of sugar when cooked; others require almost no sugar, except possibly to bring out their flavor.

Taste and aroma are so closely associated that they may be said to be almost identical. They simply represent the same thing as interpreted by different organs of sense. It is obviously desirable

Ideal Form with Flesh to Match

This is Mr. Burbank's delicious American plum, a complex hybrid which bears fruit of a remarkable uniformity, almost ideal as to form and bloom, and having the rich yellow flesh most admired in plums. It is a fruit that deserves its name.

that a market fruit should have an attractive aroma, for both market man and customer often judge the fruit by this quite as much as by the taste.

Closely associated with the flavor of the plum is the matter of a chemical content that will resist fermentation. A fruit that is too juicy and does not contain enough sugar will ferment very easily, as we have seen in connection with our studies of the prune. Some plums are peculiarly subject to fermentation, particularly if bruised in any way.

Plums that contain plenty of sugar are, as we have seen, resistant to fermentation.

This is one reason why prunes have gained in popularity for shipment in the fresh state to the eastern plum market. There is a good field for investigation as to the particular qualities, in addition to sugar content, that tend to make a fruit resist fermentation. In general it is observed that insipid fruits decay first.

Highly flavored acid fruits as well as very sweet ones tend to resist fermentation.

But the precise chemical conditions that have to do with this very important property of resistance to decay have been but little investigated. All that the prospective orchardist can do at present is to select varieties of fruit that have been shown to have good marketable qualities.

An Example of Even Ripening

The Red Ball Plum shown here approaches the ideal for market purposes, which requires that the plum not only ripen evenly throughout its flesh, but that the individual fruits ripen simultaneously. With such a fruit, the entire crop may be gathered at once—a very obvious advantage to the shipper.

Finally, there is the matter of the stone. In the case of the very soft plum, the stone may serve a useful function in giving support to the fruit. But the stone may be somewhat smaller than it commonly is and still give adequate support. In the development of stoneless plums it will be necessary to bear in mind that the removal of the stone to some extent takes from the fruit its natural support, and the plant developer will select with intent to increase the firmness of the pulp of the fruit.

Where the stone is retained it should be free, particularly in the case of the plum. The advantages of a free-stone fruit are obvious to every fruit eater. Varieties of plums have been developed in which the stone becomes practically detached from the fruit on ripening.

There is now no reason why the orchardist should not include free-stone among the qualities that he demands of his ideal plum.

If to these qualities of root and branch and leaf and flower and fruit we add the one comprehensive requisition that the texture of tree and fruit alike should have the undefinable quality that makes it resistant to disease, we have perhaps summarized in broad and general outlines the most essential qualities of the ideal plum.

It may properly enough be said that no plum

hitherto developed can measure up to the maximum or ideal standard as to each and every one of these qualities. The production of a variety that will meet these requisitions remains for the plant improver of the future—perhaps of the not distant future.

Meantime it will, I think, be admitted by those best competent to judge that there are some of my hybrid plums, notably, for example, the Wickson, the Formosa, and the Santa Rosa plums, and the Sugar, Standard and Conquest prunes, that, in their respective fields, make a fair approximation to the ideal standard. There are plums in the orchard that excel all these in some respects, but have not as yet all the qualities in combination.

—Building an ideal plant of any kind is like building a house. Each must be planned in accordance with a clearly conceived idea. But there is this great difference: in the case of the plant you must wait for Nature to supply you with the material with which to build.

Seedling Red Leaved Plum

One of the most striking of plum seedlings, being the result of Kelsey, Cerasifera, and Triflora crosses. The magnificent reds of leaves and fruit make a strikingly handsome and effective combination that is as pleasing as it is unusual.

New Plums and Prunes in The Process of Making

Some Suggestions on Which Others May Build

ON one occasion a nurseryman who had bought a number of fruit trees from me stopped before a tree in my orchard and tasted the fruit with the air of an expert.

"That's the best plum I ever tasted," he said, as he looked at the tree with admiring eyes. "At last you have a perfect plum. It has just the right amount of fruit on it; the taste is perfect! Sell me that tree and I will make a fortune from it."

"It's not for sale," I was compelled to answer.

Thinking I wanted a fancy price, he started to figure what he could pay.

I interrupted to tell him the faults of the fruit. It could not be shipped; it would not bear with any degree of certainty. He had chanced to see the tree on the very day in the year when it was on exhibition at its best. We had had a week of cool weather and all the plums had ripened slowly

together on the tree; they had responded to ideal weather—and produced a beautiful fruit of superior flavor. But conditions are not always ideal by any manner of means—and this plum could not stand adversity.

The next year the would-be purchaser saw the same tree—coming, in fact, for the further observation of it—and found the fruit worthless. For three days we had had unusually warm weather, and the fruit lacked quality. My estimate of it had been verified.

I tell the anecdote to illustrate the need of caution in judging a new fruit. The work is not over when the plum is produced; the fruit must be tested under varying conditions and in successive seasons.

But, of course, there is no great difficulty in applying the final tests. That requires only patience and open mindedness. The real difficulties were encountered at an earlier stage of the experiment.

What some of these difficulties are, and how they may be overcome, will be told in the succeeding pages. We have considered the ideal plum somewhat attentively from the standpoint of marketman and consumer. Let us now regard the same subject from the standpoint of the orchardist and plant developer.

ON NEW PLUMS AND PRUNES

The first step in plum improvement obviously involves propagation by seeds. In my own work great effort is made to secure seed of the best varieties at the outset.

As we have seen, seedlings from cultivated fruits always show a wide range of variation. Such variations offer opportunity for selection.

An Outline of Methods

The simplest method of working for improvement is to select the best seedlings thus obtained, without attempting pollenizing experiments.

An extension of the method calls for cross fertilization within the species—followed, of course, by selection.

A yet bolder method, and one calling for much more time in the work of selection, may be used—that of hybridizing individuals of different species.

Finally the method may be so elaborated that several of the best varieties of different species are intercrossed to form new varieties. The plum "Combination," as an instance, combines the characteristics of three widely varying species and of numerous varieties within these species. Most of my recent plums carry the strains of many diverse species.

This perfected method has been little used by other plant originators, but its practicality and value are demonstrated in my orchards.

The wide range of results attainable when these methods are used is shown by the fact that I now have plums the flavor of which is very similar to the following fruits: peach, apricot, apple, pear, lemon, orange, banana, pineapple, and berries of various kinds.

In addition to these, there are flavors that cannot be described because they are unique—due to new combinations or blends.

Although the flavor of a fruit is only one of its important attributes, it sometimes determines the value or lack of value of a new variety, and it is always an important factor. In many cases I have produced new varieties of plums which were good in every respect except the flavor, and because of this one defect they were destroyed.

Plums in my present colony are of every imaginable color and quality and ripen at all seasons from the earliest to the latest. Some trees have green foliage and some have purple. The trees also differ in growth in almost every imaginable way. Some are adapted to cold climates, some only to warm. Some require much moisture. Some will thrive under semi-arid conditions. A few give promise of being adapted to such a variety of climates that—like the Burbank plum—they may be grown practically throughout the plum-growing regions of the world.

The Egg Bartlett Plum

This is one of Mr. Burbank's most interesting plum developments, in that the fruit has the characteristic flavor of the Bartlett pear. It furnishes a curious illustration of anomalies that may result from crossbreeding. A plum with the flavor of the pear is a very curious product.

And the explanation of this diversity is found in the wide range of ancestral strains that have been blended to produce this versatile company.

Europe, Asia and America have furnished the foundation materials upon which have been built the sixty-two varieties of plums, prunes, and plumcots that have already been sent out from my experiment grounds since the first importation of Japan plums in 1885.

The Asiatic plums have been the most used, thirty-eight of the varieties introduced being developed from them.

Fourteen introductions were developed from American, and thirteen from European species.

Native Raw Materials

A good deal has been said in earlier chapters of the influence of foreign blood in our plum family. Let us now give recognition to the contributions of the native stock.

The native plums of America, although usually of a good flavor, are not nearly as large as the Asiatic species, and usually not as large as the American cultivated plums, and no larger than the wild ones from Europe.

But they possess the important characteristic of hardiness. For this reason, it has been necessary to use them in many cases to combine with more tender species in order that the new varie-

ties might become standards in the colder sections of the United States and other countries.

Six important American species have been used in these experiments: They are known as the American plum (*Prunus Americana*), the Wild-Goose plum (*P. hortulans*), the Chickasaw plum (*P. angustifolia*), the Western Sand Cherry (*P. Bessevi*), the Beach plum (*P. maritima*), and the California wild plum (*P. subcordata*).

These were the native wild plums of the middle western states and the Rocky Mountains south to the Gulf of Mexico. Most of them are unusually hardy. Cold does them no harm even in the northermost part of the central division of the United States.

As to quality of fruit, these wild plums differ, but all have attractive flavors, and these flavors have been blended variously in no fewer than eleven new varieties that I have thought worthy of introduction.

Anyone who has experienced the delightful flavor of my plums, Gold, Shiro, Geewhiz, Duarte, or America, will be interested to know that these new varieties (along with seven others) are American plums, reconstructed through combination with other species, but owe their flavor largely to their wild American ancestors.

To develop the earliest plum in existence from

six species of later plums seems an impossibility. Yet this is what happened when the Wild-Goose type was combined with five other late-ripening species. The plum introduced from this complex combination has been aptly named "First." It was the *first* introduced variety in the making of which the Wild-Goose had a part, and the *first* plum to ripen of all those grown in California at the time of its introduction in 1901.

If the Wild-Goose plum is mentioned, the Chickasaw should not be overlooked; for although it has not served in the production of any introduced varieties, its hardiness has contributed valuable attributes to many varieties still in the proving orchard.

But perhaps the greatest interest attaches to the story of the little Beach plum. In its wild state this is not much sought; for its fruit varies from the size of a large pea to that of a small hazel-nut, and it is inedible unless cooked. Yet this little plum has some flavor; it makes preserves of delicious quality.

The results produced on my grounds with this species are so important as to indicate that the Beach plum is highly valuable to use in the development of new plums for cold climates. I have produced four important varieties in which it is one of the parents.

June 25th Plum Fruits

This is a crossbred Japanese plum that fruits a month before ordinary plums. It has the further interest of being one of the few Japanese plums approaching the freestone character. The habit of ripening its fruit in June gives this plum peculiar value.

The story of these ennobled Beach plums is so interesting and suggestive that it is worth telling somewhat in detail.

The Ennoblement of the Beach Plum

Perhaps the most astonishing result produced by hybridizing the little Beach plum is the fruit to which I have given the provisional name Giant Maritima.

This is a second-generation hybrid from an improved hardy Beach plum pollenized with one of the hybrid Japan plums.

In 1895, the first year this seedling bore, the fruit was one hundred times larger than its seed parent, the Maritima. In 1896, the fruit was even larger than in the previous year, and in 1899, as the tree gained in age and strength, the size was still further increased.

In that year some of the fruits were measured and found to be eight and a quarter inches in circumference.

The Beach plum from which this remarkable hybrid was developed is a native of the Atlantic coast of North America, growing on the sands and among rocks near the seashore from Labrador to North Carolina. It is known botanically as *Prunus maritima.*

It is one of the hardiest of all known wild plums, and habitually productive. It is a low,

compact bush, rather than a tree, with rough, even thorny, branches, and small dull green oval leaves. The flowers are small, but are produced in great profusion, making it almost worthy as an ornamental plant. The fruits, as I have said, are small, usually less than half an inch in diameter; and they are bitter, being almost or wholly inedible unless cooked — yet making excellent preserves.

The Beach plum for many years has been known to possess some horticultural possibilities, especially hardiness, productiveness, and general "staying" qualities under the most trying conditions. The value of these characteristics was discovered soon after my general plum experiments were started, and every effort was made to cross it with some of the larger and finer species. For several years this cross could not be effected, mostly because the Beach plum blossoms very late, long after all other plums have shed their bloom.

Finally, however, very late blossoms of the latest plums of other species were cross-fertilized with some of the earliest Beach plum blossoms, the crosses being made both ways.

In the meantime I had been growing seedlings of the Beach plum by the hundred thousand. By continuous selection I had produced varieties

bearing fruits nearly an inch in diameter, of a pleasing form and color, of delicious flavor. The trees, moreover, had almost incredible productiveness together with increased size and vigor.

Although my most enthusiastic friends often laughed at these extensive experiments with what they called my "huckleberry plum," and some of the best fruitgrowers made sport of the insignificant fruit, I saw in the little Beach plum great hardiness, late blooming, enormous productiveness, and the ability to withstand adverse conditions, and was sure of some measure of success.

Several crosses were finally made between the improved *Maritima* and the best cultivated varieties of other American plums. No really good fruits were obtained in the first generation, but some excellent varieties, both in productiveness and quality, were produced in the second, third, and fourth generations.

Some of the first-generation hybrid Maritimas make a much stronger growth than their wild parents, sometimes attaining four to six feet in two years, while the wild Beach plum on a good soil rarely grows more than three to three and one-half feet high in the same time.

The wild tree has short limbs, black bark, and small leaves. The first generation hybrids of these with the American and Japanese plums have

"Three-String" Plum Fruit

On the Burbank experiment farms the plants to be saved are marked with a white strip of cloth or string. The name of this plum indicates that it has been so marked, not once, but on three occasions, a triple tribute of its value. A fruit thus honored in the Burbank orchard must have altogether exceptional merits.

longer, smoother, and larger leaves, lighter colored wood, and longer and more slender branches.

These hybrid seedlings are easily distinguished the first season, as the Beach plum has red roots, while those of the hybrid vary, most of them being lighter. Beach plum seedlings, no matter how young, from seeds crossed with other varieties, show various shades between the pale yellow or brown root of the European and Asiatic varieties and the red root of the wildling, and if there were no other test this would be amply sufficient to prove that the plants were hybrids.

Such, then, was the parentage of the Giant Maritima, which first bore fruit, as already noted, in 1905—fruit over two inches in length. When I first came across this enormous fruit on a tree with the Beach plum foliage and blooming habits, the branches literally hanging in ropes of gigantic fruits, I could hardly believe my own eyes.

The fruit begins to ripen here early in July, and when ripe it is a deep crimson, covered with a thin pale bloom. The flesh until fully ripe is very firm and solid, but it breaks down quickly when ripe. It is honey-yellow, with a pale greenish tinge. The quality is good. The fruit is fragrant, and as large as the Kelsey, Wickson, Climax, or any other plum known in 1905.

It is found necessary to thin the green fruit

carefully, otherwise the tree would be crushed with its weight of fruit. It has been grafted into numerous older trees, and appears to be a strong grower. Having originated from such an unusually hardy wild stock on one side, it will no doubt produce a crop of fruit almost anywhere. In itself, however, this will never prove of much commercial value, as it lacks firmness of texture.

The Beach Plum in Other Combinations

The wild Beach plum was also crossed with my Combination plum, which has in its ancestry plums of almost every type. The resulting seedlings were not as good as had been anticipated, but two were very much liked by a well-known California fruitgrower, and were sold to him in 1908.

One of these was given the name "East." It is a prolific variety. The fruits are globular, pale yellow, half covered with a crimson bloom and numerous indistinct dots. The flesh, pearly yellow in color, is of good quality, though probably inferior to some of the best Japanese hybrid plums. The fruit ripens here from August first to fifteenth.

This was tried at San Jose for several years, but found to be too soft for shipping. It is, however, a desirable variety for home consumption. It has never been offered to the public.

The other plum from this cross is known as "Pride." It also proved to be of little value as a shipping plum. It ripens too quickly, so that it will not stand shipping any great distance.

Pride is apple-shaped, which is usually a desirable form. It is a good grower, an excellent bearer, and ripens about July 20th. The skin of the fruit is a deep red with a whitish bloom. The flesh is a dark red—showing a Satsuma cross—and of excellent quality.

Besides these, nearly two thousand other promising Maritima hybrids are now being grown from these crosses. Many of them are excellent in habit, productiveness, and hardiness. As yet they have not been sufficiently tested to warrant their introduction.

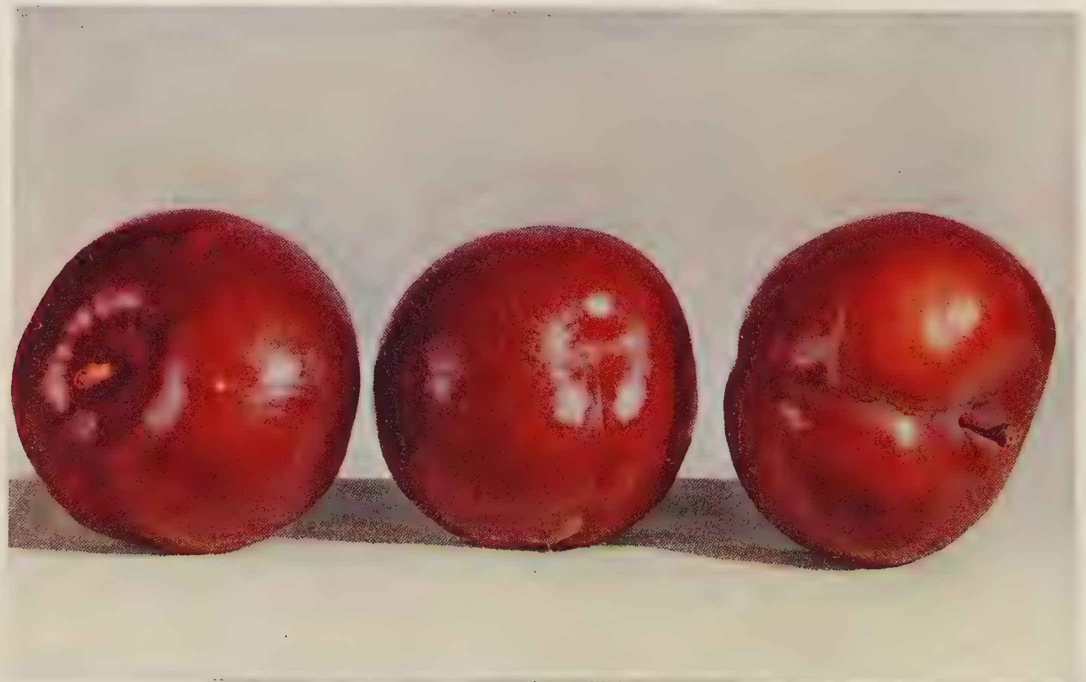
Tribute from the Sand Cherry

Another native American plum which is as hardy as the Beach plum is *Prunus bessevi* commonly known as the Western Sand Cherry. Although it is called a cherry, it is really a plum and has been successfully crossed with the plums, as pointed out in an earlier chapter. It is thoroughly hardy in the central and northern states, and is found most often in Minnesota and the Dakotas.

My work with this variety has not been so extensive as with the Beach plum, but has resulted in the development of one new plum which has

The Apple Plum

It is difficult for the casual observer to believe at first that the plum here represented is not an apple, as it has the form, color, general appearance, and rare keeping qualities of the fruit that suggested its name. It is a remarkably free grower, having led to the comment that buds and grafts of this variety "would probably grow if fired among the trees from a shotgun."



been thought worthy of introduction. It was offered in my catalog of 1911-12 under the name Epoch, and is described there as follows:

" 'Epoch' should be one of the hardiest of all known plums, as it is a cross of the western Sand Cherry and the American plum, both being about as near 'Arctic' plums as can be mentioned.

"The tree is a compact grower, dwarf, with dark brown wood, which always, without fail, produces ropes of fruit, each fruit one and a half inches in diameter, beautiful crimson, with shades and dots of yellow. Flesh pure deep yellow, firm, with a rich cranberry flavor, but sweeter, and when ripe very good. Ripens August 15th. The youngest, as well as the oldest, trees literally cover themselves with fruit, which keeps remarkably. Probably the most productive and best of all the 'Iron Clad,' *extremely hardy* dwarf plums."

As this variety has not been introduced long enough to get reports from growers in various parts of the country, it is not possible to say just how valuable it will prove to be. Its hardiness, however, is well established, for it has been grown in North Dakota, where the young trees have endured a temperature which no other plum had been able to live through.

This work of developing hardy fruits for the colder sections is being pushed by other workers.

Professor N. E. Hansen, for example, of the South Dakota Experiment Station, has been working for many years, especially in crossing the Sand Cherry with some of my best hybrid plums and with other varieties. He has been successful in producing several good varieties.

It is to be hoped that others will enter into this work, as hardy fruits are much needed in many northern regions of our country.

The California Wild Plum

Almost every imaginable flavor is to be found among the California wild plums. Some are quite sweet, some are sour, others are distinctly bitter. A few are delicious. The fruit usually is small and round, about the size of the wild plums of the Mississippi Valley; and of brilliant red color, or sometimes yellow, and rarely purple.

Strange as it may seem, the best fruit is produced abundantly where the trees are growing on rather poor soil.

The trees in different localities (and the same is true in a measure of each tree in the same locality) seem to have an individuality of their own, a somewhat characteristic condition with our California wild trees and shrubs. Some of these plum trees grow large and tall, with a straight, upright habit. Others form spreading bushes of low, compact growth that often bear abundantly

when only a foot or two high, bending to the ground with their burden of fruit.

Under cultivation this plum has improved, and some selected seedling varieties are of very superior quality. Some of these plums when cooked have a flavor closely similar to that of the best cranberries, which they resemble also in color.

When crossed with the Japanese, American, and European plums, a large and handsome fruit is developed, the form being usually nearly globular, but sometimes oval. The trees of these crosses are also greatly improved over the wild ones in form, size, and symmetry of growth. They are always hardy and vigorous, and are as a rule exceptionally prolific.

For jellies and canning, these hybrid fruits are probably superior to any other class of plums, and a few of them are most excellent when eaten uncooked. In particular one which I have recently distributed under the name "Nixie" is valuable for use in any form.

The California wild plum has also had an important part in the production of the new varieties known as Combination, East, and Glow, all plums which exhibit the superior quality of the wild parent.

Thus have the native plums of the United States been used in producing new varieties.

Another View of the Apple Plum

In noting the very peculiar apple-like character of this fruit, it is interesting, by way of comparison and contrast, to consult the earlier pictures, showing the wide variation of plum forms, including the inverted pear shape of the Kelsey, the even oval of the Splendor prune, and the almost spherical form of other types. With such material to combine, almost any results may be expected.

The European species, though used to a slightly less extent, have produced results of even wider value.

The early settlers—either because they did not expect to find plums in America, or because they were attached to their own varieties—brought plums from Europe, known botanically as *Prunus domestica.*

The plums, like the settlers who brought them, found the adopted country hospitable. They thrived and multiplied. Seeds sprang into new varieties in the fence corners and some of them bore better fruit than the colonists had seen in Europe.

It was natural that these new varieties should spread while the less valuable ones were neglected. When a farmer journeyed from Plymouth to the home of a friend near Boston and saw there a plum better than the one he had brought from Europe, he secured grafts and gave the better variety the preference on his own farm.

Thus by the exchange of grafting wood, new varieties of plums were distributed among the pioneer farmers of the new land.

The Share of Europe

To-day there are at least a hundred improved varieties of the European type of plum, all of which, up to the last few years, originated from

chance seedlings in the gardens of the first settlers.

It appears that some at least of the European plums originated in southwestern Asia. At all events, a plum that is thought to represent the original wild form has been found growing in the region about the Caucasus Mountains and the Caspian Sea.

It is known that the plum was one of the fruits and the dried prune a staple food of the Huns, Turks, Mongols, and Tartars, who maintained in this region a crude horticulture from a very early period. Here, even at the present time, plums are commonly grown and prunes are an article of trade.

The European plums have many unusually good qualities, including strong, vigorous, productive, hardy, upright trees with strong wood and branches capable of carrying heavy loads of fruit. Furthermore, they are not much subject to disease.

The fruit is not used so much for shipping long distances when fresh as some of the new Japanese hybrid plums. Some of the newer seedlings, however, such as the Splendor, Giant, Sugar, and Standard bear fruit which is shipped fresh in large quantities from California to New York and by sea to foreign countries every season.

For the most part the consumers of the large cities do not know that the big, luscious plums that they purchase in June and July are of the same varieties sold in the dried state as prunes.

The European plums have been used in the production of eight of my introduced prunes and have contributed to these the characters necessary for drying and shipping.

The European plums produce new forms readily from seed, so that it is scarcely necessary to cross them with other species to obtain seedlings with distinct new characters. Furthermore, it is difficult to make productive varieties when crossed with other species. My experience has been that they do not cross readily with the eastern or Asiatic plums, *Prunus triflora, Prunus simonii,* and *Prunus tomentosa,* nor very readily with any of the native American plums.

On the other hand, the common European plum crosses readily with the French species, *Prunus cerasifera,* the Cherry plum or myrobalan, often producing most valuable new varieties.

This French Cherry plum is a small, slender tree. It is usually quite productive, but no seedlings of large size or superior quality have ever been produced directly from it, and the fruit of its seedling is not only lacking in quality but in size and firmness of flesh.

Firm Sweet Plum Fruits

The surface dotting of the American varieties and the shape of the Japanese plum are shown in this attractive fruit, which is a complicated hybrid, the result of repeated crossing and selection. The native plums of America have had an important share, in producing some of Mr. Burbank's most prized varieties.

The only variety I have introduced which is a seedling of this plum is a cross with the Asiatic *Prunus triflora.* This hybrid is called Doris. There is blood of the French Cherry plum, however, in some hybrid plums including my well-known Shiro and a few others.

The European plums have also contributed largely to the production of new races of fruit trees that are highly ornamental. A whole race of plum trees beautiful enough for lawn decoration has sprung into being in my open air laboratory.

The French plum with purple leaves, *Prunus pissardi,* formed the basis for the development of these ornamental fruit trees. The methods used in developing these hybrids are the same as with the others, and results are similar, although the fruits have not proven so generally valuable as certain varieties raised solely for fruit.

The main use of the purple-leaved plum is for decorative purposes, but the fruits of the two varieties introduced are good enough for home use and in some cases are sold in near-by markets. This refers more especially to the very early purple-leaved plum, the Othello.

The story of the stoneless plums, which also owe their origin to European stock, has been told elsewhere and need not be repeated here.

The unique form of the apple plum, the delightful Bartlett pear flavor of the Bartlett plum, the appetizing color of the Santa Rosa, and the large size and remarkable shipping qualities of the Wickson would not have been developed had it not been for the use of the Japanese species *Prunus triflora.*

Tribute from the Orient

Indeed, the Japanese plum stands as part contributor to thirty-eight varieties added to American horticulture. These thirty-eight plums have been sent out from my farms, and few nursery catalogs list more than four or five Japanese plums other than these varieties, although several have been developed by other workers.

China, as well as Japan, has furnished material for the development of highly valuable plums. The well-known varieties, Maynard, Climax, Chalco, Santa Rosa, and Formosa, and many other newer seedlings, have in their make-up the blood of *Prunus Simonii,* the Apricot-plum of China.

This fruit takes its name from Eugene Simon, who introduced it into France from China in 1872. It was distributed in this country about 1881. It is peculiar in shape, being a large, flat, tomato-shaped plum, with dark brown, hard flesh, purplish-red skin, and a small stone.

The fruit is sometimes eatable, and sometimes classed as good when grown in the hot, dry climates of the interior valleys of California. Its merits and defects were outlined in an earlier chapter. Here I will only add that it is by no means necessary to have a perfect fruit to begin your experiment. I have in many cases developed the very best of new fruits from two nearly worthless ones.

In selecting the Simon plum for these experiments, its value for plant improvement was considered and not its value as a market plum.

As a result of its use, its small stone, delightful aroma, and desirable tree characters have been imparted to a new race of plums, several of which have already added thousands of crates a year to the shipments of the principal plum growing sections.

Others even more promising are still in the test orchard awaiting final approval.

Such, then, are the materials that have been utilized in the development of new fruits in my plum orchard. I have used the native plums of the Middle West, the worthless wild plums of the bleak coast of Labrador, the plums of the Pacific slope; those which our forefathers brought from Europe; a worthless, wild, half-stoneless plum; plums from Japan, some with red flesh; other

Globe Plum Fruits

It will be seen that the flesh and the skin of this plum are almost uniform in color. This is a very unusual characteristic. The plum is a complex hybrid, and the red flesh betokens a Satsuma ancestor. Although named, this plum has not as yet been introduced.

Japanese and Korean varieties with large bright colored fruits and delightful flavors; the apricot plum from China, the purple-leaved plum from France and the cerasifera, which has been grown mostly for grafting stocks.

Although some of these species are insignificant in themselves, their characters by combination and careful selection have had a share in making fruits of the rarest qualities.

And the work, notwithstanding its notable results, is only at its beginning.

The Mystery of the Bud

In completing this outline of the methods of plum development, let us now consider a little more in detail an aspect of heredity which concerns equally all our other cultivated orchard fruits, and which must seem mysterious to everyone who gives the subject a moment's consideration. I refer to the familiar but extraordinary fact that whereas the bud or cion of a given tree will reproduce the fruiting qualities of the parent with the utmost fidelity, yet the seedlings grown from the fruit may have the widest diversity.

It has been pointed out that you need not hybridize the orchard fruits in order to get new varieties. The seed of almost any plum tree, for example, will give you seedlings a plenty that are different from the parent tree.

That the germ plasm of a single tree may thus contain the potentialities of a hundred different types of future fruit, is a mystery to which we have referred, but to which we may recur without apology.

When we further reflect that the branch in question, which carries this amazing heritage, perhaps grew from a single pea-sized bud inserted on the trunk a few seasons ago; and that the tiny bud in question must have contained, pre-determined within its seemingly insignificant substance, all the potentialities that will be revealed in all the different "varieties" of its progeny, the mystery becomes still deeper—if comparison be permitted between the various aspects of a subject every phase of which lies almost beyond the bounds of human comprehension.

But even though we cannot hope fully to understand, much less to explain, the mysteries of heredity of which the case of the bud furnishes a familiar yet striking example, we cannot help pondering on the matter. And as nowadays we are accustomed to associate function with structure everywhere in nature, seeking a physical basis for the observed phenomena associated with life processes, it is natural that here as elsewhere attempts should have been made to visualize the conditions that obtain in the germ plasm of the

plant, and to picture in imagination its actual mechanism.

In our age the telescope, fortified by the weirdly penetrative spectroscope and aided by the photographic plate, has enabled the astronomer to reach out into unthinkable realms and to record not merely the direction and speed of light but even the chemical composition of stars so distant that their light, traveling 186,000 miles per second, requires scores of years to reach the earth.

With the aid of the same instrument, the universe is proved to be peopled with dark stars, definitely revealed to us even though forever invisible; the structure of the universe as a whole is coming to be understood, and the course and direction and speed of groups and streams of stars by millions have been tested and charted.

In such an age it is not strange if the worker who turns his eyes in the opposite direction, and attempts to penetrate the mysteries of the microcosm of the plant or animal cell should have found means to pass beyond the range of vision of the microscope and reveal something of the intimate nature of the events that are taking place in the world of molecule and atom and electric particle.

Aid from the Microscope

In point of fact the invasion of the world of the infinitely little by the modern biologist has

Early Crimson Plum Fruits

This particularly realistic direct color photograph print shows a plum which bears unusually early, and which reveals in its characteristics a combination of the wild California, European, and Japanese plums. The strains of the different ancestors are blended in very complex combinations, through repeated crossing.

been no less wonderful than the exploration of the world of the infinite vastness by the astronomer.

And perhaps it should not seem strange to any one who has a philosophical conception of the underlying harmonies in nature, that the conditions revealed in the microcosm of the living cell should suggest in many ways an epitome of those made manifest in the macrocosm.

Such, at all events, is the message that the modern biologist and physicist bring us from the world of infinite littleness. Making the first stages of their invasion with the aid of a microscope, they show us that all living tissues, vegetable or animal, are composed of cells, and that within each cell there is a vitally important central structure called the nucleus.

This structure lies at the heart of every germ cell through which a living organism propagates its kind.

The pollen grain of the plant, for example, is the carrier of such a germinal nucleus. The pollen grain itself is a structure of almost microscopic size, yet it is colossal in comparison with the infinitesimal fleck of germinal matter that lies at its center. Yet the modern microscope can so magnify this fleck of matter that something of the mechanism of its vital parts becomes visible.

The microscopist tells us that within the germi-

nal nucleus there are to be seen sundry films of matter, arranged to form a sort of skeleton, which are readily stained under his manipulation and which he therefore names "*chromosomes*", colored bodies. He observes that the nuclei in the cells of different plants and animals have these infinitesimal chromosomes arranged in different characteristic groups, differing in number in different species but always the same for each and every cell of plants or animals of a given species.

The enlarged vision of the microscopist enables him to assure us that when two germ cells of the opposite order come together—when, for example, the nucleus of a pollen grain blends with the nucleus of the plant ovule—there are various characteristic dividings and interlinkings between the two sets of chromosomes within the two nuclei.

In the blending and rearrangement of these minute structures, he believes that he is witnessing the underlying processes that bespeak the blending of hereditary potentialities and their re-combination to determine the future possibilities of the new organism that is thus brought into being.

All this is very wonderful. But it brings us after all only one stage nearer the confines of the mystery. The chromosomes within the nucleus, which all biologists nowadays regard as the tangible carriers of hereditary tendencies or capacities, are

few in number, and small as they are, we are forced to conclude that each of them must be the carrier not of a single potential trait or tendency but of a multitude of such potential traits or tendencies.

Our practical experiments in plant breeding have shown us that we deal often with a dozen or more tangible characters that are grouped against each other in opposing pairs—definitive qualities of size or color or flavor of fruit and all the rest—and it requires but a moment's thought to see that each of these "unit characters" is in reality made up of a multitude of minor characters.

Heredity carries all of these definitely from one generation to another; so their potentialities must be represented within the structure of the chromosomes; and there are by no means chromosomes enough to supply one for each hereditary character.

So we are obliged to assume that each chromosome is in itself a complex structure, and that within that structure there are subordinate structures—like the individual bricks and boards and nails and rivets that go to make the structure of any piece of human architecture—that determine by their quality or their arrangement the specific potentialities of the future organism. Each chromosome, in other words, must be thought

The Home Chestnut Plum

Like all Mr. Burbank's recently developed new varieties, this is of complex ancestry. It is less celebrated than many other varieties that have been developed at Sebastopol, but it has qualities that make it an admirable fruit for the door yard and home garden.

of not as the tangible conveyer of any particular "unit character", but as a receptacle in which several or many factors or determiners of diverse unit characters—size of flower and color quality of leaf and fruit and all the rest—are assembled.

Further Aid from the Physicist

But unfortunately the powers of the microscope do not suffice to reveal these unit structures within the chromosome.

What they are like, must for the present remain only a matter of conjecture.

But that they are definite mechanical structures of unthinkable smallness, represented by chemical atoms in specific combinations, we can not doubt. And in revealing to us the size and character of these atoms, the modern physicist gives us aid in supplementing the vision of the microscopist and in helping to make it seem at least a possibility that the definite factors of heredity have a physical basis within the microscopic chromosomes.

The conclusions that give this assurance are based on various almost infinitely delicate tests that are made in the modern physical laboratory.

Summarizing these in a few words, it appears that the physicist and chemist are now able to make definite computations as to the size of the molecules and atoms that make up the structure of all matter. And the figures they present, when

they have taken a census of the atom, are such as to give us full assurance that even so small a structure as the minutest chromosome within the nucleus of a plant cell contains molecules and atoms in such numbers as to make possible an infinite complexity of arrangements and therefore an infinite diversity of resulting qualities.

Thus we are told that the smallest particle of matter visible under the magnifying influence of the most powerful microscope is of such dimensions that 50,000 of such particles placed in line would be required to cross the space of one centimeter or about two-fifths of an inch. If we calculate the cube of this number we find that 125 thousand billion such particles could be crowded into the space of a cubic centimeter. But it further appears that, according to a definite measurement made by Professor Rutherford, more than 20 billion times that number of helium atoms would exist in the form of gas in the same space.

And the commentator I am quoting adds: "Of course the molecules of gas are widely separated. So it follows that the smallest particle of solid matter visible through the most powerful microscope contains many times 20 billion atoms."

"Many times 20 billion atoms" in the smallest particle of matter that the microscope reveals! Vastly more than that number of atoms, then, in

each individual chromosome of the group lying within the nuclei of pollen grain and ovule—since these are by no means at the limits of visibility. And each atom has itself specific individuality. Each group of a thousand atoms or so might make up a molecule of a different type of protoplasm.

So here is material for millions of kinds of protoplasm, were so many needed.

Here within the infinitesimal germ cell, revealed to us in part by the microscope of the biologist and for the rest made manifest in imagination by the revelations of the physicist, is material enough to supply tangible carriers for all the conceivable hereditary factors that come to make up the most complex organism of any plant, or for that matter of any animate creature whatever.

The Germ Cell A Complex Organism

Let us make the illustration specific. Suppose that the chromosome in the nucleus of any given pollen grain—say that of a plum blossom—were of the very smallest size visible under the microscope. Suppose, also, merely for the sake of illustration, that the hereditary factors for unit characters that it bears are of a thousand different types—representing all details of size and color and foliage and growth and leaf and blossom and fruit of the future tree. We know that the chromosome really does bear these potentialities;

The Turkey Egg Plum

Where hundreds of new varieties of fruit are in evidence each season, it is often difficult to find names appropriate to designate them. Someone suggested that this handsome plum is shaped like a turkey egg; so the name was appropriated. Names aside, this fruit is luscious and palatable, as a glance at the picture will suggest.

I am merely assuming their number at a thousand individual units for the sake of illustration.

In our former views, when we considered the transmission of complex qualities by the infinitesimal pollen grain the thing seemed utterly inscrutable and mysterious. But now with the aid of the new facts that the physicist has supplied us, the mystery is somewhat clarified. He shows that the smallest visible bit of protoplasm must contain at least twenty billion atoms.

So there would be enough of these atoms to supply no fewer than twenty million to make up the structure of each individual hereditary factor.

Now twenty million bricks, of ordinary size, piled solidly together, would make a mass 100 feet square and 300 feet high.

So the structure of each hereditary factor of all the thousand in our infinitesimal speck of germ plasm may be as complex as any building that could be made with such a pile of bricks as that—and more complex, no doubt.

Add that each individual atom in our germ plasm structure is no crude brick but is conceived by the best informed students of physical science to be "at least as complex as a piano", and we gain a yet clearer conception of the possible intricacies of the mechanism of each of our imagined thousand hereditary factors.

In this view, then, the germ cell may well be an organism as complex and of as definite a system of architecture as the full grown tree into which it will ultimately develop.

The leaves of a tree—even the leaves of a forest—are a meagre company compared with the census of the atoms within the nucleus of a single germ cell.

An Amazing Microcosm

Nor need we limit our view to the germ cell that produces a single plant. Let us consider for a moment the bud from which the branch grew on which are produced, according to our illustration, plums, the seeds of which may give rise to some hundreds of different "varieties" of fruit.

Do the analyses of miscroscopist and physicist make comprehensible the fact that the original bud of the plum tree can contain potentialities of so many different complex structures?

Another glance at the figures of the physicist will supply an answer that would have been bewildering were it not for what we have just seen as to the complexity of the germ plasm. It appears that, according to the estimates of Professor Rutherford (based on accurate count of the atoms given out as so-called alpha particles in the radiation of radium) the mass of an atom is so inconceivably small that the number of atoms making

up a portion of matter as big as our plum-bud (which we may assume to have the bulk of about a cubic centimeter) is represented by the figures 68 followed by twenty-four ciphers—68 "octillions", if the figures must be read.

So the number of atoms that are aggregated in the tiny plum-bud is vastly greater than the total number of people that have lived on the earth since the human race was evolved.

To attempt to give tangibility to the idea of the smallness of the atom, we may borrow an estimate made by the late Lord Kelvin. It may be computed that if the tiny plum-bud were imagined to be enlarged in size until it became as big as the earth, each component atom being increased in the same proportion, its entire structure would then be made up of units (magnified atoms) of about the size of footballs.

If we then reflect, further, that according to the definite analyses of other physicists, with Sir J. J. Thomson of Cambridge at their head, each atom is itself a complex structure—the very simplest atom, that of hydrogen, being composed of at least 1,700 particles called electrons which are in reality the unit particles of electricity—we shall gain a still more enlightening view of the complexity of our plum-bud microcosm.

It has been estimated by a French physicist,

The Bully Plum

Sometimes the chance remark of a visitor suggests the name for a new fruit. So it was with this plum which brought forth a slangy but expressive ejaculation that seemed highly appropriate, and was retained. No one who looks at the picture will doubt that this is really a "bully" plum.

Becquerel, that the size of the individual electrons that make up the atom is such that they may be thought of, not as piled solidly together within the structure of the atom, but rather as infinitely separated by comparison, like a swarm of gnats flying about in the dome of a cathedral.

It is a little difficult for anyone not accustomed to this particular use of the imagination to follow the conceptions of the physicist. But we may accept his findings as authoritative, for they are the result not of one man's work alone but of tests that have been applied by many workers.

Making the application to our plum-bud, then, it appears that its bulk is such as to give us assurance that it contains (although it actually is no larger than the smallest pea) a number of atoms so great that if the atoms were conceived to be all gathered into 8,000 different groups (each group representing a different variety of future plum), there is material enough to supply at least eight million billion atoms in each group! And each of these atoms is itself a complex structure made up of several thousand electric corpuscles.

Now we know that each particle of protoplasm, the physical basis of all life, is composed of atoms of carbon, hydrogen, nitrogen, and oxygen in complex combinations. A single molecule of protoplasm may contain a thousand or more atoms.

But even allowing a thousand atoms to each molecule, we have ample material for the construction of something like eight million billion molecules for each one of our 8,000 groups of potential plum trees.

Obviously there is abundant opportunity for the combination of such material into complex groups, quite adequate to account for the different qualities of our various plums—be they never so divergent as to form or size or color or flavor.

The Bud as a Walled City

In this expanded view, then, it is no more wonderful that a pea-sized plum-bud can contain within its germ plasm the potentialities of hundreds of varieties of future plums than that a city can comprise hundreds of houses, no two just alike, all built of wood, brick, stone, and metal in different proportions and combinations; just as the germ cells are all built of the atoms of carbon, hydrogen, nitrogen, and oxygen in different combinations.

There are far more bricks (atoms) available to build each different type of germ plasm in our plum-bud colony than are required to build the largest structure in the man-made city.

The real wonder, as I said before, lies in the fact that each infinitesimal aggregation of molecules of protoplasm has the capacity to take to

itself stray atoms that are brought into its neighborhood, shape them into its own structure, somewhat as a brick-layer shapes the bricks into the walls of a building, and thus increase constantly in size.

It is this capacity of the germ plasm to gather material and utilize it in expanding its structure—together with the further capacity to move in response to environing forces—that is the underlying mystery of the entire life-process, including the interesting aspects of it that we see manifested through heredity.

In a word, a fruit-bud is a walled city tenanted with a multitude of complex structures, and the mere size of the bud, in our clarified view, has nothing whatever to do with the wonder of its composite architecture.

The phenomena of the germ cell have hitherto appeared peculiarly mysterious simply because our blunt human senses deal ordinarily with masses of matter of a more tangible size. Now that the microscopist and the physicist have opened the way for us into the microcosm, we see that mere size is of no great significance in the matter, and that there is ample opportunity within the nucleus of the smallest germ cell for an organization of molecules and atoms that for all practical purposes may be at once as complex and

Big and Handsome but Nameless

This big flat plum is of very mixed ancestry. In shape it suggests the Kelsey, which was doubtless one of its ancestors. Note the hollow under the seeds, from the breaking of the flesh, which is a characteristic and an interesting peculiarity of this plum.

as definite as the visible structure of the mature plant in which the germ cell sprang or of that other mature plant into which it will develop.

—The work, notwithstanding its notable results, is only at its beginning.

What The Burbank Plums and Prunes Have Earned

The Opportunity Which Improvement Opens Up

THE BURBANK plums and prunes have earned money for everyone except the originator. Introducers, growers, canners and shippers, transportation companies, dealers, and consumers have made and saved money from these fruits.

The originator, on the other hand, as nearly as he can estimate, has received about 50 cents on each dollar invested in the work of plum development.

My experiments altogether—nearly one-fifth of which have been devoted to plums and prunes —have cost me very nearly $250,000. The income from the sale of new varieties has been approximately $100,000. Up to 1912 I was about $150,000 behind on all my experiments. But the loss on the plums has been less, probably, than that on a good many other lines of experiment,

and there is reason to believe that varieties not yet introduced will presently bring a return that will more nearly balance the account.

Meantime the sums earned for others by the Burbank plums and prunes after they have gone out into the world have been really significant, from whatever standpoint considered.

As illustrating their earnings in a single field, we may note that in the season of 1912 there were 564 carloads of Burbank plums of different varieties, aggregating 396,133 crates, shipped from California alone to the eastern markets. This represented more than one-third of all the shipments of plums. The average price per crate received for all Burbank plums was $1.20, as against $1.03 the reported average for other varieties. The maximum price per crate for any Burbank plum was $3.25 (Wickson), as against a maximum of $3.04 for any other variety; the highest average prices per crate being respectively $1.71 (Maynard) and $1.45.

The total wholesale price of the Burbank varieties of plums shipped in this single season was not far from half a million dollars.

If individual varieties are under consideration, the plum specifically known as the Burbank excels any other single variety by a large margin; the figures being, for the Burbank, 116,764 crates

Typical Wild Worthless Plum Seedling

This is a hybrid plum that harks back to a wild ancestor. The thin wood and slender leaves indicate that it will not be a good bearer.

and for its closest competitor 98,149, a difference in favor of the Burbank of 18,615 crates.

If prices are taken into account, the lead of the Burbank becomes still more significant, the highest price per crate for this plum being $1.93, and its average price $1.12. The total revenue from shipments of this single variety of plum was more than $130,000.

And all this, of course, refers to the Burbank plums merely as shipping plums from a single district. It takes no account of prunes, the handling of which constitutes an altogether independent industry. Nor does it, of course, refer in any way to the shipment of plums from any region except California. Yet the Burbank plums are grown everywhere, and in some remote regions as, for example, South Africa, they are raised on the largest commercial scale. The bushmen of Australia are perhaps as familiar with the deep yellow, juicy, tender but firm flesh, and the sweet aromatic flavor of this plum as are the orchardists of California. It is equally well-known in New Zealand, in England, in France, in Nova Scotia, and in Southern Canada, and in this country it has become the standard in all the states except Wyoming.

The total number of nurserymen in America who list Japanese plums is 150, and of these 142

list the Burbank; a record not approached by any other plum.

A More Comprehensive Valuation

But these figures, and any others of like character that might be collated, serve, after all, to give only a vague and general idea of the economic importance of the new plums.

Statistics having to do with shipments to the great markets, even were they available for all territories, would tell but a small part of the story. The true benefits accruing from this work cannot be reduced entirely to figures.

A large proportion of the earnings, for example, have been protective—in the nature of assuring large and regular yields of superior quality; thus giving significant returns each year instead of uncertain yields occasionally.

Again, even the most elaborate statistics would entirely fail to present the facts at their true value, because the identity of a plum is often lost through the prevalent custom of renaming varieties. The Abundance plum, as an instance, has been designated "Botan," "Botankio," "Chase," "Yellow Japan," "Douglas," "Oval," and probably by other names by the growers and sometimes also by the nurserymen and dealers. The Wickson plum has been sold under the name "Eureka," and similar liberties have been taken to a greater

or less extent with each of the 20 Burbank varieties that are prominent as shipping plums.

Therefore the figures based on the records of distribution, growth, and sale of a variety are sure to be far below the correct figure.

But most important of all is the fact that a very large part of the entire plum crop is grown for home consumption or for distribution in local markets, of which no record is available. With the wide distribution of Burbank products over the entire world, in many cases in countries where no systematic public records are kept, there are unrecorded benefits, profits, and earnings to the extent of millions of dollars annually, of which no accurate estimate can be made.

And, finally, even if complete up-to-date records of the earnings of the Burbank plums could be collated, the figures would give but a vague idea of the real importance, from a purely economic standpoint, of the work that has been accomplished, for the reason that it takes a long time to introduce a new fruit, whatever its importance, and the best Burbank plums and prunes have been developed within very recent years. Of my quartette of "best" plums, only the Wickson has been on the market long enough to acquire anything like the reputation and the vogue that its merits justify. As to the others, Formosa

Small, Poor Foliage

This specimen is perhaps even less desirable than the preceding one. Such a seedling may be at once discarded without waiting for it to bear fruit. As is said by the Yankees of poor help, "it will be found waiting for pork at sundown" instead of performing satisfactory work.

was introduced in 1906, Santa Rosa in 1907, and Beauty, perhaps the best of all, only in 1911.

So whereas we find that the Wickson was shipped from California in 1912 to the extent of one hundred carloads, there were only two carloads of Formosa and fourteen carloads of Santa Rosa recorded, and of course Beauty is not represented at all.

Obviously, then, the earning power of these newest and best plums is a matter for the future. When the statistics are collated, let us say for the year 1925, it will be possible to gain a clearer view of the real importance of these new productions.

Of course, orchardists are proverbially conservative. Perhaps it is natural that they should be so, considering that they deal with trees that require some years to come into bearing. An orchard cannot be made in a season, like a grain field, but the rapid conquest effected by the Burbank plum and the Wickson leaves little room for doubt that my newest plums will make their way no less effectively in the course of the coming decade.

Fortunately for the fruit grower, he may introduce these new Burbank varieties with less loss of time than usually attends the introduction of ordinary plums.

Mosaic Variation

Occasionally a seedling shows a mottled leaf like this. Such a seedling, although otherwise promising, is rejected. In this case vigor of growth in the tree is indicated by the size of the leaf and wood, but a leaf of uniform dark green color is to be preferred. This is interesting, however, as showing a peculiar segregation of color factors, one of the ancestors having been a purple-leaved plum.

All of the older varieties in an ordinary California plum orchard require five or six years growth before they commence to pay for themselves. But most of the new Burbank varieties will commence to bear heavily in the third or fourth season, and by the fifth or sixth year they will have produced as much as the ordinary plum orchard four or five years older.

Why Plant Creation Is Costly

Since I have spoken of the losses sustained by the plant originator in developing fruits that bring such large monetary returns to others, perhaps I should explain a little more at length why it is that the plant developer who experiments as I have done cannot hope for a quick financial return for his efforts.

One chief reason why experimentation of this order does not pay is that it was done so comprehensively, thoroughly, and on so large a scale.

Where a man conducts plum improvement, for example, as an adjunct to a nursery business, there is no reason why he might not eventually secure even a single improvement that could directly pay him for his care and expense in producing it. There would be no certainty as to this, to be sure, as the chance of securing a really good new variety is not better than about one in ten thousand. That is to say, in handling ten thou-

Foliage of Fair Promise

These are leaves of fair shape and a good degree of vigor. This seedling may be depended upon to produce a fair amount of fruit, although perhaps not an exceptional quantity or fruit of unusual quality. It is an average specimen of the kind which is worth preserving and testing.

sand seedlings, there would be no probability of securing more than a single good new variety.

But, on the other hand, sometimes even a small lot of seedlings may give more than one good variety, as was the case with my original twelve seedlings from Japan.

In any event, the nurseryman can carry out a line of experiment on a moderate scale without considerable monetary outlay. So at worst he will lose very little.

But where innumerable crosses are made and thousands of seedlings are raised each year only to be destroyed; and where all needed improvements are worked for together as in the combination of a great number of species and varieties—instead of taking a certain established variety and attempting to make one or two improvements upon it—there must necessarily be a much greater proportion of expense.

But, so far as my own experiments are concerned, the pioneer work has now been done. I have elsewhere told how the material has been gathered from all over the world, until the plums and prunes of my orchard carry hereditary strains in their germ-plasm from ancestors imported from five continents.

And I have pointed out that there are thousands of new varieties among my plum trees that

Typical Good Bearer

The branch here shown, the essential qualities of which are admirably reproduced in the color print, may be taken as a typical example of a good bearer. This may be depended upon to produce fruit in abundance, and of the best quality consonant with its inheritance.

have exceptional qualities, and from the progeny of which, variously interblended, many new and important races of plums and prunes will doubtless be developed in the immediate future.

The sum total of my work with the plums and prunes, judged by the record of actual introductions, comprises the development of only 62 new varieties. But it must be understood that these 62 introduced varieties are only the pick among thousands, very many of which were but slightly inferior to the ones chosen. And, as I said before, the final balance sheet for my work with this fruit cannot be struck for many years to come.

My plum orchard might be compared, in this regard, to a large number of modern industries, manufacturing establishments, for example, which have a high first cost and which cannot be expected to pay more than the interest on the investment for a good many years, yet which may ultimately show a profit that will pay back the original expenditure and even give a balance on the credit side of the ledger.

Plant Improvements Cannot Be Patented

There is, however, one feature of plant development that puts it on a different plane, as regards probable financial returns, from that occupied by most other fields of inventive or creative industry.

This is the fact that nothing comparable to a

Typical Good Purple Leaf Plum

A tree with purple leaf always contrasts pleasantly in the landscape with the usual green trees. The purple-leaved plum is a particularly interesting tree. Mr. Burbank has made experiments in combining it with the usual green-leaved plum. There is an interesting segregation of colors in the second generation of such crossbreed varieties, resulting sometimes in the mottled leaves shown in earlier plates.

patent can be obtained on new varieties of fruit trees or flowers, such as the developer of new, mechanical inventions or chemical combinations, or artistic productions can depend upon to guard his invention and make it at least probable that he will share in the profits that accrue from its introduction. The plant developer must either introduce his new varieties through direct sales to nurserymen and planters, or else sell them outright for a comparatively small sum to a wholesale dealer. In the latter case he receives a sum that is never large. In the former case his returns are altogether problematical, and at best there are only two or three years during which he has a partial monopoly of the sale of the product of his labors.

In three or four years, according to the rapidity with which the new variety can be multiplied, orchardists who have purchased grafting stock can compete in the market with the original introducer.

Suppose, for example, that I have a new plum that I decide to introduce directly. I sell grafting wood by the foot. The highest price I have ever received for grafting wood, even of the choicest new variety, is $10 a foot.

This, to be sure, is at the rate of about $800,000 a cord, if you choose to reckon it that way; but

Purple Leaved Plum with Fruit

This is the so-called oval crimson variety of purple-leaved plum. It is a fruit of very attractive appearance and of rather good quality; which is by no means usual with the fruit of the purple-leaved plum. As a rule these plums are prized for their ornamental foliage rather than for their fruit.

unfortunately you sell only a very small fraction of a cord. There is not likely to be any very active demand for a new variety of plants, or until it has been tested out in several localities. Meantime, the first purchaser, in making the test, has grown a large quantity of twigs from his grafted cions; and with this, obviously, he can enter the market on an equal footing with the original producer.

Thus, a single foot of wood gives enough buds to graft a strong, vigorous, young tree; and from that tree enough wood may be taken next year to graft nearly an acre of orchard. After that, of course, the supply is practically unlimited.

Thus the cost of securing a plum or prune orchard of the very choicest variety is absolutely insignificant; to say nothing of the fact that the enterprising purchaser, when he has demonstrated the value of the new product, can sell grafting wood to his neighbors in such quantities as to pay back many times over his original outlay—even though, as sometimes happens, he makes the sales at only a fraction of the price charged by the original introducer.

In this way, it is clear, any orchardist who purchases cions of a new stock may quickly enter into competition with the original producer or the firm that has purchased the right. Often the second man that comes into the field may take

A Diseased Specimen

Instead of showing the vigor that usually characterizes hybrids, this specimen shows an impoverished condition of the nutritional system, which should lead to the rejection of this seedling. It might be compared with a tubercular or ill-nourished animal, and it cannot be depended upon to produce good fruit. The wise plant developer would never give it an opportunity to come to fruiting age.

advantage of the advertising done by the first, and quite possibly make as great a profit as the producer and the original introducer. And each local nurseryman may in turn take up the work of distribution, supplying the local demand.

So the few feet of grafting stock that the original plant developer sold for a mere fraction of what it had cost him to produce the new variety, have within a few years multiplied to make up the thrifty branches of scores or hundreds of orchards, until every one who desires the fruit is supplied, without an additional cent coming to the pocket of the originator.

This was what I had in mind when I intimated in the beginning that the most successful new fruits, which bring fortunes to a large number of dealers and growers, may represent financial loss to the originator.

Incidental Profits from the New Plum

Not to dwell unduly on this aspect of the subject, however, let me point out a little more in detail some of the benefits conferred by new fruits having exceptional merits.

For example, a fruit may make an exceptional profit for the grower merely because of the fact that it comes into bearing very early in the season, before the market is glutted with fruit of other varieties.

A Weakling

This seedling has a weak stem and not enough leaves. It is not unhealthy, but it simply lacks vitality. It may be rejected without further tests.

The Burbank, Santa Rosa, Climax, and Formosa plums, among others, are striking examples of this feature, as they come into bearing very early. Several of these have come into the market at a time when it is nearly bare of fruit.

Another advantage is secured to the fruit grower by varieties that are regular and abundant bearers. Regularity of bearing is a factor for which I have worked constantly, and it has been instilled into all my new varieties of plums. These trees are not constructed on the hit or miss plan. They can be depended on to give a crop each year. It requires no argument to show that the expense of starting an orchard can be paid much more rapidly by trees that will bear abundantly each season. An enormous crop every other year would not at all take the place of even a moderate crop every year. But, in point of fact, my new plums are not only regular bearers, but most abundant bearers as well.

Sometimes the grower is deceived by receiving a large price for a variety of fruit that is produced in such small quantity as to bring a meager aggregate return.

The wise orchardist, however, will look for a fruit that will produce abundantly and at the same time bring a good price per basket. The Tragedy at $2.00 a crate would generally pay much

Leaves Showing Mixed Inheritance

This is a crossbred seedling, descended from purple-leaved and green-leaved ancestors. The segregation of colors in the second generation has been referred to, and is illustrated here in a very interesting way. Most specimens have leaves that are all green or all purple; but here and there one mixes the colors, in a way that has peculiar interest for the student of heredity.

less than the Burbank at $1.00 a crate, owing to the difference in the productiveness of the two varieties. But, in point of fact, the Tragedy, even with its small production, averages (according to the returns of last year) only 19 cents a crate more than the Burbank. And of course the Burbank was one of my early introductions. Some of my newer plums quite outclass it in selling value.

All of the most successful of my new plums are early bearers and produce large and attractive fruit. The purchaser desires a large, high-colored, handsome fruit, and he is not disappointed if he finds that it has excellent quality also.

Then, in order that a fruit shall earn money for its grower, it must be adapted to stand shipment to a distant market. Many beautiful plums lack this quality and as a consequence never have been, or can become, valued fruits for commercial shipping by the carload.

But my new plums have been developed with this need constantly in mind. I have recognized that a fruit to become of importance for shipping long distances must have a number of qualities that hitherto have not been required in fruit. It must be of texture that will not break down in handling and shipping; it must retain its flavor, or even have improved flavor if picked before it is quite ripe; and it must remain firm and hard not

A Tree of Vigor

A typical branch of the Burbank plum showing the strong, sturdy stem and the heavy, abundant foliage. These leaves suggest strength and vigor, and in point of fact the Burbank plum is famed for these qualities. The fruit itself has been shown in earlier pictures.

only throughout the long journey but during subsequent days until it can be placed among the retail distributors.

Very few plums in existence to-day are wholly up to these standards of excellence. The Wickson, one of my early introductions, fulfills these conditions better than any other plum hitherto produced. But there are several among my prospective introductions that will excel even the Wickson.

Often one new character in a plum, prune, or plumcot doubles its earning capacity. The shipping qualities of the Wickson; the color of the Santa Rosa; the flavor of the Geewhiz or Nixie; the bloom of the Plumcot which enables it to be placed on the market as fresh in appearance as when first taken from the tree—these are examples of characteristics that double the earning capacity of the fruit.

Incidentally, we must not fail to note that improved varieties of plums and prunes have greatly enhanced the earnings of the transportation companies. Where fruit is shipped by the carload, it can be handled economically by the railways, and as transportation is an essential link between the producer and consumer, there is no difficulty experienced by the common carriers in securing an adequate price for their work.

Another minor point that might readily be overlooked is that the Burbank plums increase the earnings of the retail dealer, who not only makes a direct profit from their sale, but so beautifies his exhibit by introducing these large and handsome fruits as to attract customers, and thus facilitate the sale of his less attractive fruit as well.

Finally, the earnings of the Burbank plums advantage the ultimate consumer. The new plums can be produced so much more cheaply that sooner or later this reduction in cost of production will rebound to the benefit of the final purchaser. He gets the fruit at half the former price. The fruit itself is of greatly improved appearance and quality, yet it costs less than smaller, less attractive, and less highly flavored plums formerly cost. So in the end the consumer shares the profit of the Burbank fruits with all the other parties concerned.

If in conclusion I revert to the statement that nobody is made financially poorer except the originator of the fruit, it is only that I may add that he also receives an adequate reward in the knowledge that he is a benefactor of all parties concerned and a detriment to none.

If he can only pat himself on the back, while others may pat themselves on the purse, perhaps his satisfaction after all is not less than theirs.

Siberian Apricot

This represents a typical specimen, showing the ability of the apricot to dry without fermentation after having fallen from the tree. The stone is large in proportion to the size of the fruit, but it holds an edible kernel, giving the fruit additional value for the nomadic tribes that utilize it.

Accomplishing the Impossible —The Plumcot

A Cross Which Man Had Said Could Never Be Made

SEVERAL years ago a party of noted scientists from various parts of the world were visiting my nursery.

I asked one of them—an American, even then well known to the public as an authority on horticultural subjects—to come over to another part of the grounds and see one of my crosses between the plum and the apricot; one of my first crosses then just ripening.

"There can be no such fruit," my visitor declared. "The two species are wholly different in all respects. Everybody knows it is impossible to cross two trees of such widely varying types as the plum and the apricot."

I was not surprised to hear him make this statement. For at that time very few biologists—and in particular few technical botanists—had quite given up the notion that there are hard and

fast lines between the different species as commonly classified.

This belief has undergone a radical change, in recent years, and the many combinations of widely different species made on my Sebastopol grounds have had at least a share in broadening and clarifying the views of the classifiers.

"Well, what kind of a tree do you think this is?" I asked a moment later.

"Why, a plum, to be sure."

"Please examine more closely, professor," I requested. "This leaf looks to me more like an apricot than like a plum!"

"Yes—yes. I see now it is; it is surely an apricot—the leaf, though differing from most of the apricots, is certainly an apricot leaf."

"Now look again, carefully—look at the foliage, bark, branches; and now let us examine the fruit. Then tell me what you really think it is."

After a long and thorough examination, I heard the reluctant decision: "Well, it surely is what you claim it to be—a cross between the plum and the apricot. I never thought it could be made."

I told him I had hundreds of others of different sizes, shapes, and qualities.

"Show me another—quick! quick!"

And I showed him not merely one other, but a score or two, to his added mystification.

The Odd Plumcot

This fruit, as the reader is aware, has very exceptional interest because it is a hybrid produced by crossing species so widely separated as the plum and the apricot. The cross was successfully made only after a long series of futile experiments. Now, however, Mr. Burbank has a large number of varieties of plumcots.

When the apricot and plum were crossed to produce an intermediate fruit, the accomplishment was thought by some botanists to savor of a violation of the laws of Nature.

Breaking Down A Barrier

Notwithstanding the general acceptance of the idea of evolution of species, a reminiscence of the old special-creation point of view lingered. Even if existing species have evolved in the past, they were thought to be fixed in the present; or at any rate to be separated by impassable hereditary gulfs.

If, by a rare chance, species did interbreed, it was supposed pretty generally that the offspring must necessarily be sterile.

Therefore, when the statement was made that I had crossed the plum and apricot, and produced a healthy and vigorous new fruit, it was met with profound skepticism from most quarters.

But it was only necessary to bring the skeptics to the trees themselves and introduce them to the new fruit to convince them that what they considered impossible had really been accomplished. The Plum-apricot hybrid attests its heritage convincingly to any competent observer.

As we have elsewhere seen, the apricot has been found difficult to improve, because of its lack of adaptability—pliability, as it may be

called. The tree thrives, blossoms well, but rarely fruits in this region, chiefly because of the tenderness of its blossoms. Partly because the climate here made it difficult to attempt the improvement of this tender plant, I decided to try crossing the apricot with the plum, which thrives unusually well in this locality.

Had I known how much time and labor and patience these experiments were to demand, they might never have been undertaken. Plant improvement of any kind tests purse and patience; but the improvement of tree fruits strains both to the breaking point. Working with vegetables or flowers, it is possible to get valuable improvements well under way in from three to five years —after which, continued selection makes progress more rapid.

With tree fruits you have only just begun after a dozen years of crossing, growing, testing, and selecting.

Nevertheless it was with pleasurable anticipations that I began these experiments which later were to produce the plumcot. It was like entering an unexplored country.

Apricot flowers were dusted with plum pollen and plum flowers with apricot pollen. But for a long time the experiment failed.

Finally, however, when I about despaired of

success, several crossbred seedlings were found among a lot grown from the seeds of a Japanese plum that had been pollenized with various apricot blossoms.

The young seedlings could be early distinguished from the uncrossed seedlings by the foliage, bark, buds, and general appearances; differences being noticeable while the seedlings were still less than a foot high. The combined characters of the plum and the apricot were to be noticed in the bark, the leaves, the buds, and especially the roots. The apricot root is bright red while the plum root is yellow, pale yellow or almost white. The hybrid seedlings had red roots.

Battling Heredities

With the recognition of characteristics began the great work of selecting and discarding.

Moreover, fresh hybridizing tests were made, and in due course other hybrids were produced, some having the plum and others the apricot for the seed parent. Where cross-fertilization could be effected, it made no difference which way the species were crossed.

But the conflict of hereditary tendencies was at once apparent. Hybrids appeared that departed widely from the traditions of either parent. Moreover, there was the tendency to sterility that

Sweet Plumcot

Among the hundreds of plumcots originated in the Burbank Experiment Farms there is every variation of the combination of plum and apricot qualities. The variety here shown is called the sweet plumcot; it closely resembles the apricot in the quality of its flesh.

threatens the offspring of every wide cross. One of the first plum-apricot hybrids produced did not have a stamen on the whole tree. It was evidently a cross of the plum and apricot, but in the combination the means for perfect reproduction was overlooked. Experiments were made by applying pollen to the malformed blossoms. But few ripened—the majority remaining dormant.

The cross brings out this striking malformation, but there are doubtless almost numberless tendencies striving for mastery that remain submerged, seemingly neutralizing one another—perhaps destined ultimately to come to the surface under influence of a changed environment.

At every stage of the development and improvement of a plant short cuts must be introduced, where time and expense can be saved.

Instead of waiting years for a seedling to bear, it is possible to save much of that time by the application of well known methods of grafting, elsewhere described. Some of the most vigorous and best growers of the hybrid seedlings were grafted into older plum trees. After two or three years several of them began to bear fruit abundantly.

The grafts showed that fruit would actually be produced—fruit of fine quality; this much was assured.

Intermediate Form of Plumcot

The typical plumcot differs so widely from either of its parents that it is entitled to be called a distinct species. Some varieties, however, show a peculiar segregation of the parental characteristics. The specimen here shown reveals the plum ancestry in the mottled character of its skin, while the seed, blossom-end of the fruit, lopsidedness and firmness of flesh, indicate apricot parentage.

And it was a fruit of a new order—neither apricot nor plum. In view of its origin, it seemed appropriate to christen the new fruit the Plumcot.

Parental Resemblances

The new fruit is similar to the plum in its firmness and color. In form also the cross usually follows the plum parentage, for every shape that is seen among the many thousands of varieties of plums is also seen among the plumcot seedlings. But there are varieties also that closely resemble the apricot in form.

The stones vary widely, some of them almost duplicating the apricot stone, and others being similar to the plum stone. A few varieties have stones which resemble the peach stone in many respects, especially in the corrugated and honey-combed appearance and in thickness of the shell. There is no uniformity in the color of the stones. Some of them are almost white, others yellow; a few are wine colored; and there are browns of various shades.

The sharp, knife-like projection from one edge of the stone—a characteristic of the apricot—is found in many of the seeds of the plumcot.

Notwithstanding these extreme variations, however, it is usually not difficult to distinguish between the plumcot seeds and those of the plum or apricot. They are usually plumper than those

Plum-Like Plumcot

This is the plumcot named the Bearer. At first view the fruit gives the impression of a Japanese-American hybrid plum, but the short, thick wood, the prominent buds, peculiar bark, and especially the fuzz indicate apricot parentage. The apricot characters are prominent in the tree; but the fruit is, on the whole, distinctly plum-like in appearance.

of the plum, and have an individual appearance that would be noticed by anyone who examines them.

Some stones are attached to the flesh, while others are free, some are smaller than the stones of either the plum or apricot, while some are much larger, comparable to the peach stone.

The flesh of the new fruit is—the flesh of a Plumcot.

As great production as could be desired, combined with large size and other good qualities, had not up to that time been produced. This lack, while discouraging for the time, was by no means an insurmountable obstacle to the production of a fruit comparable in its relative perfection to our other standard fruits.

When it is possible to add to the most stubborn plant, practically any desired element—color, hardiness, earliness, or any other it may lack—the plant improver may be assured that productiveness can also be added.

In order to give an idea how a number of seedling plumcots proved up, the following test records of some of the plumcots produced are listed. It is to be remembered that these are some of the results of earlier experiments.

On consulting my record books, I find that the earlier Plumcots were usually listed as poor to

The Abundance Plumcot

The characteristics of the Satsuma plum and the apricot are plainly shown in this color print of the Abundance Plumcot. The fruit holds the apricot shape and has the short stem and blossom-end of the apricot. In other fruit characters it resembles the plum parent, the serrations of the leaf, however, being those of the apricot.

medium growers, and almost without exception as poor bearers. Such records as these are typical: "No. 10—Poor grower; fruit small. No. 14—Strong grower and poor bearer. No. 16—Poor grower and poor bearer. No. 18—Medium grower and poor bearer."

This is not as discouraging as it might seem on the face of it. All of the trees represented by the above numbers bore regularly; they produced a fair crop every year. Moreover, there were others that were listed as "medium" bearers, and even as "heavy" bearers.

One of these now fruiting produces such an enormous quantity of fruit that it would seem impossible for the tree to hold it; the branches are literally crowded with plumcots from base to tip.

Quality also is good. So this variety gives a good basis for more seedlings and for crosses that will produce regular and abundant bearers of fruit of superior quality.

The plumcot was at first slow of improvement owing to the comparatively few seeds available, and the time it took those to come again to bearing, yet a number of varieties which combine the pleasing quality of the apricot with the hardiness and productivity of the plum are already in existence.

The larger proportion of the successful crosses

A Superior Plumcot

This delicious plumcot, as yet unintroduced, possesses marked freestone characteristics, a quality very unusual among the Japan plums that figure among its ancestors. Apricot parentage is indicated by the smooth stone and by the shape and ridging of the fruit. The flesh, by its red color, shot with yellow, indicates plainly the Satsuma plum, modified by apricot influence. As an example of mixed inheritance, therefore, the fruit has exceptional interest. As an edible fruit it will appeal to any palate.

between the apricot and the plum have been made with the Japanese plums. Few seedlings have been raised from the apricot trees pollenized with the Japanese pollen, the seeds generally being produced on the plum tree.

The seedlings of the second generation show an astonishing number of variations. Although both trees and fruits of these variations usually resemble both parents in various respects, yet we are so unaccustomed to seeing such combinations of characters that they appear to be new.

In fact, the *combinations* are new, though the characters exist in the heredity of one parent or the other; but these are often greatly intensified in certain individuals.

Further Characteristics of Tree and Fruit

The foliage, growth and general appearance of the plumcot trees most often combine the characters of the two species in such a way that it is impossible to classify them either as plums or apricots. There are, of course, many gradations, so that some trees much resemble the plum, while others closely resemble the apricot.

Several varieties of the new plumcots were exhibited at the Pan-American Exposition at Buffalo in 1901. The exhibit aroused interest—both for its novelty and beauty and because of its promise of a new fruit for the orchardist.

The Best Plumcot

In describing this as the best plumcot, it should be understood that present results alone are referred to. It is not unlikely that still better plumcots will appear in the course of successive seasons. This beautiful and delicious fruit has Satsuma flesh, and apricot stone and flesh texture, with stem and other fruit characters well balanced between the plum and the apricot. It is an appetizing and palatable fruit.

As announced in The California Fruit Grower of May 24, 1903, a special gold medal was struck as an award—though no award had been scheduled, or could have been for any such exhibit. Such fruit had probably never been thought of by the board of awards or any one else.

Such recognition was pleasing. Yet the plumcot in 1901 was far from being a perfect fruit. It was rather in the experimental stage. Further work in cross-breeding and selection was requisite for its perfecting.

The first one of these plumcots introduced was sold to John M. Rutland of Australia.

Mr. Rutland came from Kiewa, Australia, and lived near my Sebastopol proving grounds for several years in order to study these new fruits, as well as the cactus and other of my productions. When he saw this plumcot, he thought it good enough for introduction. Accordingly, in July, 1905, he purchased the right of distribution in the Southern Hemisphere, including all of Africa. He named this variety the Rutland.

The following year the new fruit was introduced in the Northern Hemisphere by George C. Roeding of Fresno, California.

The Rutland has long, slender branches and long, slender leaves. It is a completely balanced combination of the Satsuma plum and the apricot.

Cherry Plumcot

This beautiful fruit is a curious combination. The fruit itself is a true plumcot, whereas the stem and leaves are distinctively those of the plum. The coloring and dotting of the skin are characters that reveal the plum parentage; but the other qualities of the fruit are closely suggestive of the apricot.

The exact pedigree of the Rutland is inferred rather than known. The crosses were so numerous and so complicated at that time, that no attempt was made to keep an exact record of all of them. There is little doubt, however, that Satsuma is one of the parents, because the flesh of the Rutland is red, and the Satsuma was the only plum which had red flesh that I was using for crossing at that time.

The fruit of the Rutland is large, globular, cling-stone; both the flesh and the skin are of a deep crimson color. The flesh has an acid flavor until mature, and when fully ripe resembles the Satsuma in its acid qualities. Its principal value is for jam and jellies. There are a dozen or more bearing trees of this variety on the Sebastopol place, and they have never failed to produce a crop each season. The amount of fruit, however, is too small to make the trees valuable commercially in this climate.

The Rutland was a fruit of unusual scientific interest, and was introduced partly under that consideration—not merely as a commercial fruit. It was sent out as a curiosity, the type specimen of a new kind of fruit and the forerunner of numerous good varieties that will follow.

Fixity of the New Species

It might be thought that seedlings from plum-

cots would revert to the type of plum or of apricot, but they do not. The combination is complete and permanent. Among the many thousands of seedlings which have been grown, not one has produced either true plum or true apricot. All are plumcots. It is therefore plain that the new fruit is fixed as a species.

Of course it is not expected to fix any of the varieties so that they will come true to seed, any more than any variety of plum or apple or pear will come true to seed.

Nevertheless, the mixed heritage of the new fruit is not altogether obscured. The tendency to segregation of plum factors and apricot factors in the second and succeeding generation is variously manifested. It would probably be feasible to select specimens that by inbreeding and selection could be made to develop races fairly duplicating each of the parental stocks. Such an experiment would have scientific interest rather than practical value.

The plumcots are still new; they have not been introduced to the general trade long enough to be fully tested in many parts of the world. It was hoped from the outset that among the new varieties some would be found bearing fruits equal to or better than the apricot in flavor, on trees at least as hardy as the standard varieties of plums.

This expectation has been realized in a variety of plumcot that has been named the Apex.

This makes it possible to raise delicious apricot-like fruits in many localities where the apricot cannot be grown.

The Best of the Plumcots—Up To Date

The best of the plumcots so far produced is that just mentioned, the Apex, a final selection in 1911. It ripens with the very earliest of the early plums, about June 10. This means that its season is about three weeks earlier inland. It has not been fruited sufficiently long in other localities to know how it will yield elsewhere.

The tree is a strong, upright grower, and has never failed to bear a full crop, even where apricots are failures. In some cases the Apex has borne a full crop of fruit even when the plums were a short crop on account of unusual weather conditions. This fruiting capacity is unusual in plumcots of such superior quality, and marks the beginning of a new race of plumcots as productive as the plum and as valuable as the apricot.

The fruit of the Apex is extremely handsome, and very large for an early fruit, being 5½ to 6 inches in circumference. It is globular, and pink, or light crimson in color. The flesh is honey yellow, firm, rich, aromatic, resembling that of the apricot, and sweet and delicious to the taste.

Plumcot Seedling Cluster

At first glance this direct color photograph print might be taken for a cluster of Japan plums, but the finely serrated apricot leaf shows it to be a plumcot. Perhaps the most striking characteristic of this particular variety is its abundant bearing; and this is a matter of great importance, as many of the apricots have been rather shy bearers, and Mr. Burbank is working with particular reference to improvement in this direction.

The Apex tree is a much stronger grower than the Rutland, and produces perhaps ten times as much fruit. The fruit is larger and much earlier. It has yellow flesh instead of crimson, making it one of the most valuable market varieties.

The Apex resembles the apricot very decidedly in form, size, and quality of fruit, while it is more like the plum in foliage, upright growth, productiveness, and smooth-skinned fruit. It thus illustrates the tendency to segregation of unit characters along Mendelian lines to which reference has been made.

The Apex is the only plumcot yet introduced which has promise of becoming a standard market variety, though there are others equal or superior to it to follow. Its ability to withstand the requirements of long shipping have not been thoroughly tested, but its firm flesh and tendency to ripen slowly are strong indications of its value for transcontinental shipment.

The exact parentage of the Apex is not known. The crosses have been so extensive and complicated that a complete record was thought of less value than the production of a fruit that would feed the millions. It is certain, however, that the Apex, like the Rutland, carries blood of the Japanese type of plum combined with that of the apricot.

ON THE PLUMCOT

The Triumph plumcot was introduced by myself in 1911, having been, like the Apex, previously tested for several years. It is fairly productive here, the fruit ripening about August 1. It is of apricot form, is six inches around, with velvety purple skin, thickly dotted and mottled with scarlet. The flesh is firm and apricot-like in texture. It is not so promising as a shipping fruit as the Apex because of its deep crimson flesh and lateness of ripening.

The Triumph is primarily a home fruit, and is valuable because of unique combinations of the apricot and plum qualities.

During the several years this variety has borne fruit, the trees have never failed to bear at least a medium crop.

Another plumcot introduced at the same time as the Triumph is known as the Corona. It is a strong, upright growing tree, bearing beautiful, large, golden-yellow fruit with a velvety skin. The fruit usually develops a red cheek when perfectly ripe. It is firm, sweet or subacid, and delicious. The Corona is a cling-stone. It ripens July 25. It is an unusually rapid-growing tree, but it is not so productive as the Apex. It will probably be grown only for home use. It is possibly hardy enough to be grown in many localities where the apricot does not fruit, and may be appreciated

there because of its resemblance to the apricot. Besides the varieties that have been introduced, I have some thirty other selected varieties that have been given temporary names, for further testing. Some of these will doubtless be introduced if, as expected, they prove of value.

Hundreds of other seedlings are being tested but have not developed sufficiently to give a very definite idea of their qualities.

Hybridizing the Plumcot

Now that the plumcot race has been thoroughly established, it is necessary to make further crosses.

The obvious way to obtain improved varieties is to cross the best seedlings of those already produced. This is being done every year. Seeds of all of the plumcots grown on my place in 1912 were saved and planted; possibly two thousand of these seedlings being grown.

One of my named varieties that has not been introduced is perhaps the most prolific fruit tree ever produced. The seeds from this are being saved separately. It is probable that the seedlings grown from this variety will be remarkable producers.

By crossing some of the plumcots with the *Prunus pissardii* plum, some purple leaved plumcots have been secured. This characteristic of dark foliage is readily transmitted in the plumcot cross as

The Plumcot called the Burbank

This is one of the most delicious of the plumcots. It will be seen from the direct color photograph print that this variety resembles the common cultivated crabapple in appearance. This is probably accounted for by the fact that one of the ancestors in the original cross had the shape of the crabapple; though this plumcot is otherwise very different indeed from its progenitor.

it is in the plum crosses. It is expected that by this cross one or more varieties of plumcots will be secured that are valuable both for fruit and foliage.

The purple-leaved plum trees have proved of great value for decorating lawns, and the plumcot trees are considered of even more value by some, because of the unique combination, and the brilliant color of the foliage.

From a study of the plumcots already produced, it is safe to say that this new fruit will become known and grown in all climates where deciduous fruits are found. Numerous improvements must be made before the plumcot will become as popular as either of its parents. But only time and patient selection are required to effect these improvements.

It is quite possible that in many regions the plumcot may in time replace the apricot as well as many of the plums.

But more important by far than the quality of the plumcot as an orchard fruit is the lesson it has taught as to the possibility of producing new fruits by hybridization.

The plumcot stands as the first addition to the list of orchard fruits that has been developed within historical times. Apples, pears, plums, peaches, cherries, apricots, quinces—all were

Cluster of Apex Plumcots

This variety of plumcots shows a pretty even balance of the characteristics of the plum and apricot ancestors. The fruit is very large for an early bearer, being from 5 1-2 inches to 6 inches in circumference. The flesh is honey-yellow, firm, rich, aromatic, resembling that of the apricot, and sweet and delicious to the taste. The Apex is the only plumcot yet introduced which has promise of becoming a standard market variety, though there are others equal or superior to it in the proving orchard.

known to the Romans and Greeks and to their forbears of Oriental antiquity. The plumcot is a new species that originated just at the close of the 19th century.

Its production forecasts a new era in fruit development.

[END OF VOLUME V]

—Plant improvement of any kind tests purse and patience; at every stage of the work shortcuts must be introduced in order that time and expense may be saved.

List of Direct Color Photograph Prints in Volume V

Apricots

Plums

Plumcots

LIST OF ILLUSTRATIONS (Continued)

Prunes